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FINAL

Bioventing Pilot Test Work Plan for Site ST200 (SA38)

McCLELLAN AIR FORCE BASE
CALIFORNIA

Prepared for

Air Force Center For Environmental Excellence
Brooks Air Force Base, Texas

and

Environmental Management
McClellan Air Force Base, California

June 1997

Prepared by

PARSONS ENGINEERING SCIENCE, INC.
2100 WEBSTER STREET, SUITE 700, OAKLAND, CA 94612 • 510/891-9085
OFFICES IN OTHER PRINCIPAL CITIES
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FINAL

BIOVENTING PILOT TEST WORK PLAN FOR SITE ST200 (SA38)

at

McCLELLAN AIR FORCE BASE, CALIFORNIA

Prepared for

Air Force Center for Environmental Excellence
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SECTION 1

INTRODUCTION

1.1 SCOPE AND OBJECTIVES

This Bioventing Pilot Test Work Plan presents the scope of an *in situ* bioventing pilot test and installation of a bioventing system for treatment of petroleum hydrocarbon-contaminated soils at Site ST200 at McClellan Air Force Base (AFB), Sacramento County, California. The primary goal of the bioventing system is to remove the potential source of groundwater contamination from the soil. The system is not designed to reduce contaminant concentrations in groundwater. Four main objectives toward achieving the goal of removing contaminants from the soil are: 1) assess the potential for supplying oxygen throughout the petroleum hydrocarbon-contaminated soil zone, 2) determine the rate at which indigenous microorganisms will degrade the contaminants in the soil when stimulated by oxygen-rich soil vapor, 3) evaluate the potential for sustaining these rates of fuel biodegradation, and 4) gather baseline data which can be used in the future to evaluate the effectiveness of bioventing in treating site soils.

The bioventing pilot test will determine the technical feasibility of bioventing at this site and establish important design parameters such as air permeability, radius of influence, and fuel biodegradation rates. A significant amount of the contamination should be biodegraded during the pilot test since bioventing will take place within the most contaminated soils.

Additional background information on the development and success of the bioventing technology is found in the document entitled *Test Plan and Technical Protocol for a Field Treatability Test for Bioventing* (Hinchee et al., 1992) and *Principles and Practices of Bioventing* (Leeson and Hinchee, 1995). These protocol documents will serve as the primary references for the pilot test well designs and detailed procedures which will be used during the test. In addition, a General Engineering Evaluation/Cost Analysis (EE/CA) document in support of using bioventing as a presumptive remedy has also been prepared (Stanin et al., 1996).

Much of the background information used in this Bioventing Pilot Test Work Plan is derived from prior studies and reports, which are listed in Section 7.

1.2 HISTORICAL SUMMARY OF BIOVENTING AT MCCLELLAN AFB

Bioventing has been implemented by Parsons Engineering Science, Inc. (Parsons ES) at six other McClellan AFB sites: Tank Farm #2, Tank Farm #4, SA6, PRL T-46, Davis Global Communications, and Capehart Gas Station (Engineering-Science, Inc. [ES], 1994; AFCEE,

1995; Parsons ES, 1996a). Data from each of these sites has demonstrated the effectiveness of bioventing as a remediation alternative for petroleum hydrocarbon-contaminated soils at McClellan AFB.

Based on initial air permeability and respiration testing, biodegradation rates of 40 to 2,500 mg of fuel per kilogram of soil per year and a typical radius of influence of 30 to 50 feet were estimated for these sites. Each site was resampled after one year of operation of each bioventing system and residual hydrocarbon concentrations generally were reduced by an order of magnitude or more, especially concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) (AFCEE, 1995). At Tank Farm #4, residual concentrations of fuel hydrocarbons in soil have been reduced to non-detect concentrations and concurrence has been received from the lead regulatory agency for No Further Investigation (NFI) Status (CRWQCB, 1997).

1.3 REPORT ORGANIZATION

This Work Plan consists of seven sections, including this introduction. Section 2 includes a site description, history, and summary of previous investigation activities and analytical results. Section 3 discusses proposed site activities including installation of the bioventing system, system tests and monitoring, soil and soil vapor sampling, and quality assurance/quality control procedures. Section 4 discusses Base support requirements. Sections 5 and 6 provide the proposed project schedule and points of contact. References used for preparation of this report are provided in Section 7. Appendix A contains copies of available ST200 boring logs.

SECTION 2

SITE DESCRIPTION AND HISTORY

2.1 SITE LOCATION AND HISTORY

2.1.1 McClellan AFB

McClellan AFB, an Air Force Logistics Center, is located approximately 7 miles northeast of downtown Sacramento and covers approximately 3,000 acres (Figure 2.1). Employing approximately 15,000 civilian and military personnel, the base provides worldwide logistics support for weapons systems, equipment, and commodity items as well as maintenance, supply, and contracting services. The base was established in 1936 and since that time has managed, maintained, and repaired various aircraft, electronics equipment, and communications equipment. These operations have generated various hazardous and toxic wastes, including: industrial solvents, electroplating wastes, heavy metals, PCB contaminated oils, jet fuels, and a variety of oils and lubricants.

Hazardous wastes were disposed of at a variety of burial pits, sludge pits, and miscellaneous disposal trenches and pits. In 1979, groundwater contamination was discovered and subsequently base production wells were shut down. Since that time, base production wells have been retrofitted with well head treatment systems, numerous monitoring wells have been installed, and three groundwater extraction systems have been installed to prevent migration of contaminants. A groundwater treatment plant was constructed in 1985.

Numerous environmental investigations have been performed throughout McClellan AFB as part of the U. S. Air Force (USAF) Installation Restoration Program (IRP) and an Interagency Agreement (IAG) between state and federal agencies. Possible sources of contamination at McClellan AFB identified in prior studies are grouped by geographic area, designated as Operable Units (OU) A through H (Figure 2.2). Each OU was further broken down into geographic investigation clusters (IC) comprised of multiple sites. An additional OU separately addresses groundwater contamination. ST200, also known as SA38, is located within IC25 in OU A (Figure 2.2).

2.1.2 ST200

ST200 is located on the east side of the Base and covers approximately one acre (Figure 2.3). The site is comprised of a former automobile service station building (Building 26) and associated landscaping. ST200 is bounded by Arnold Avenue to the east, an asphalt-paved driveway and parking lot to the north and west, and Building 24 to the south. Building 24

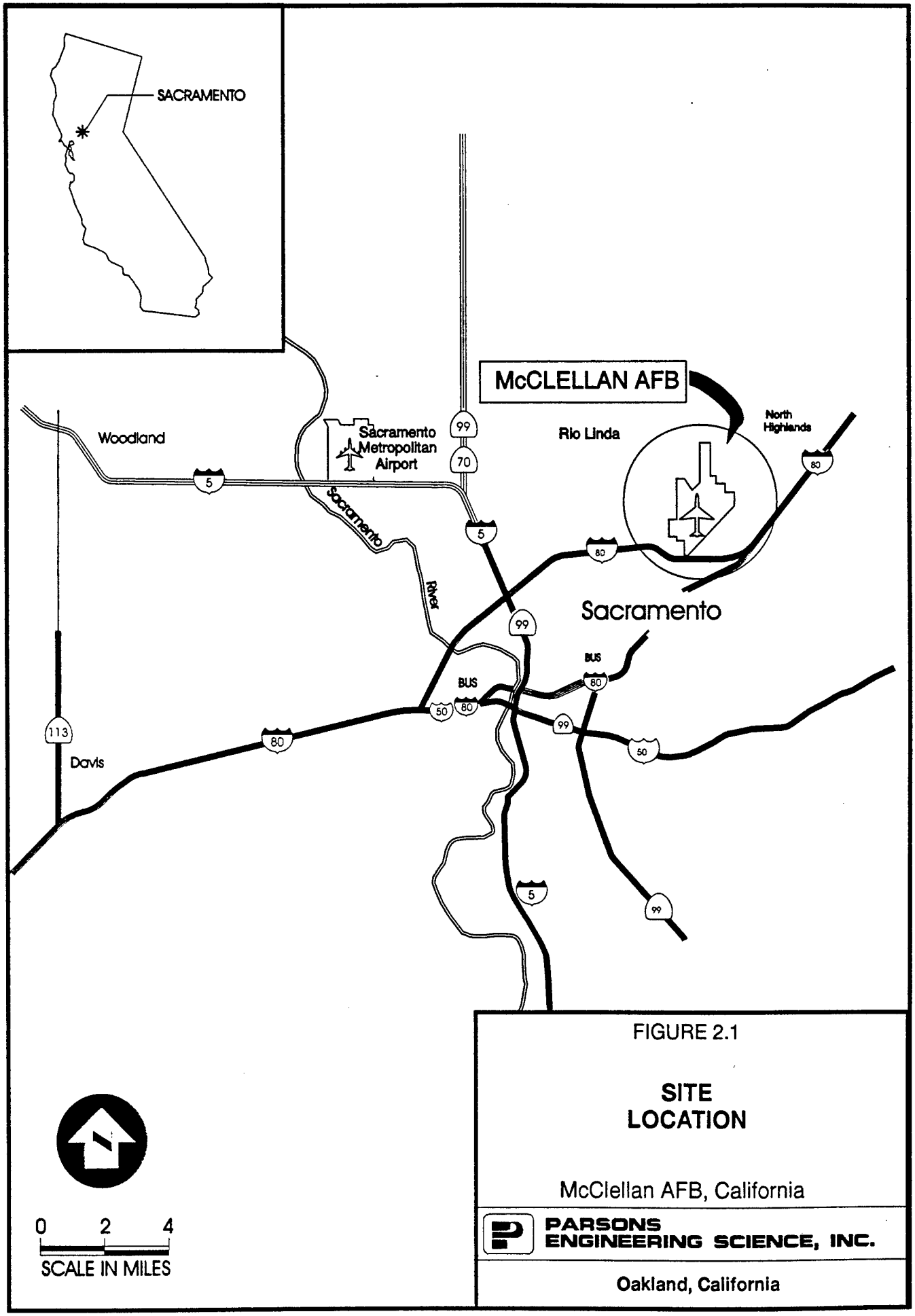


FIGURE 2.1

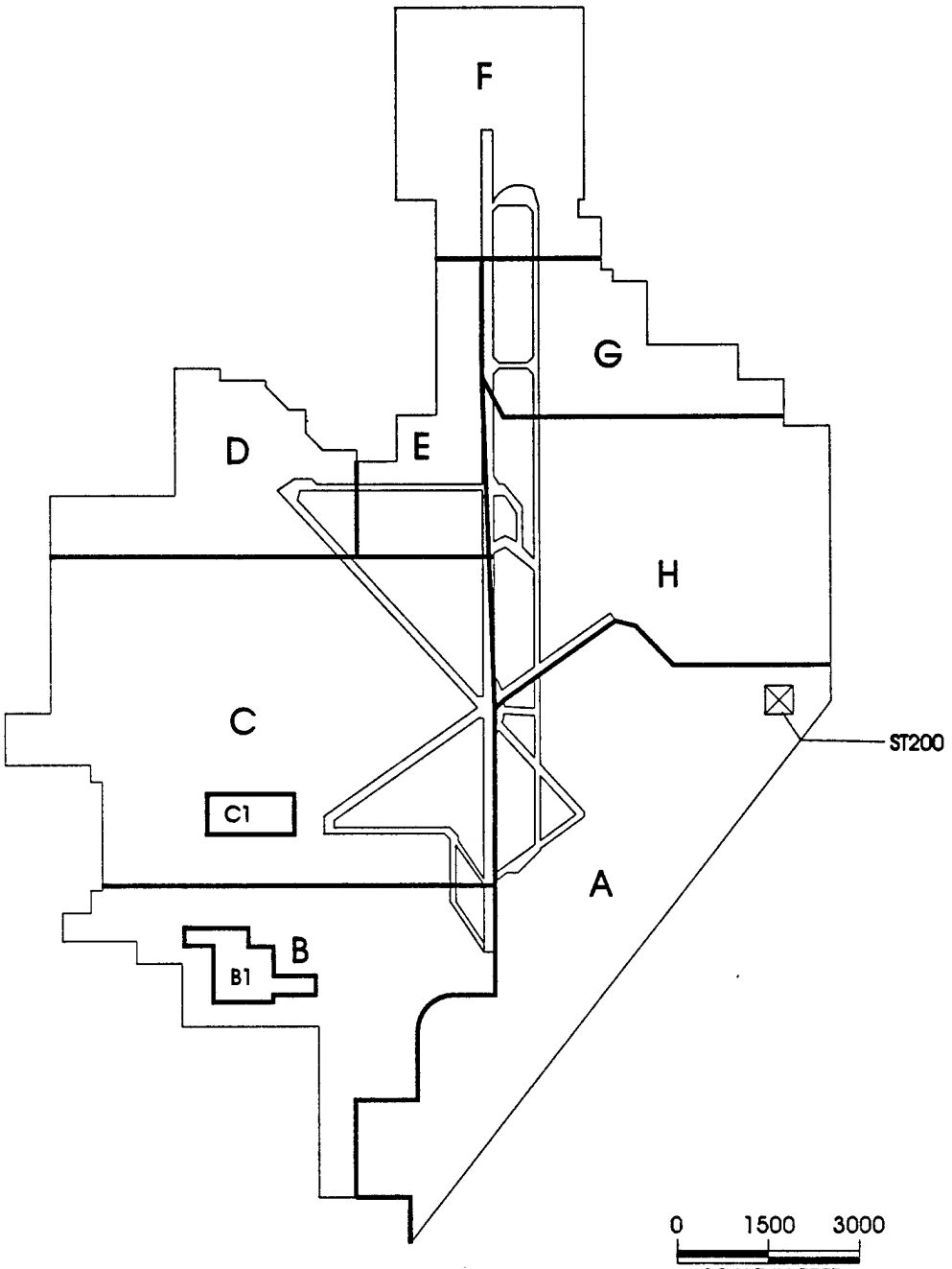
SITE LOCATION

McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.

Oakland, California

MCC11-01.CDR 3/14/97



EXPLANATION

BOUNDARIES OF OPERABLE UNITS

McCLELLAN AFB BOUNDARY

FIGURE 2.2

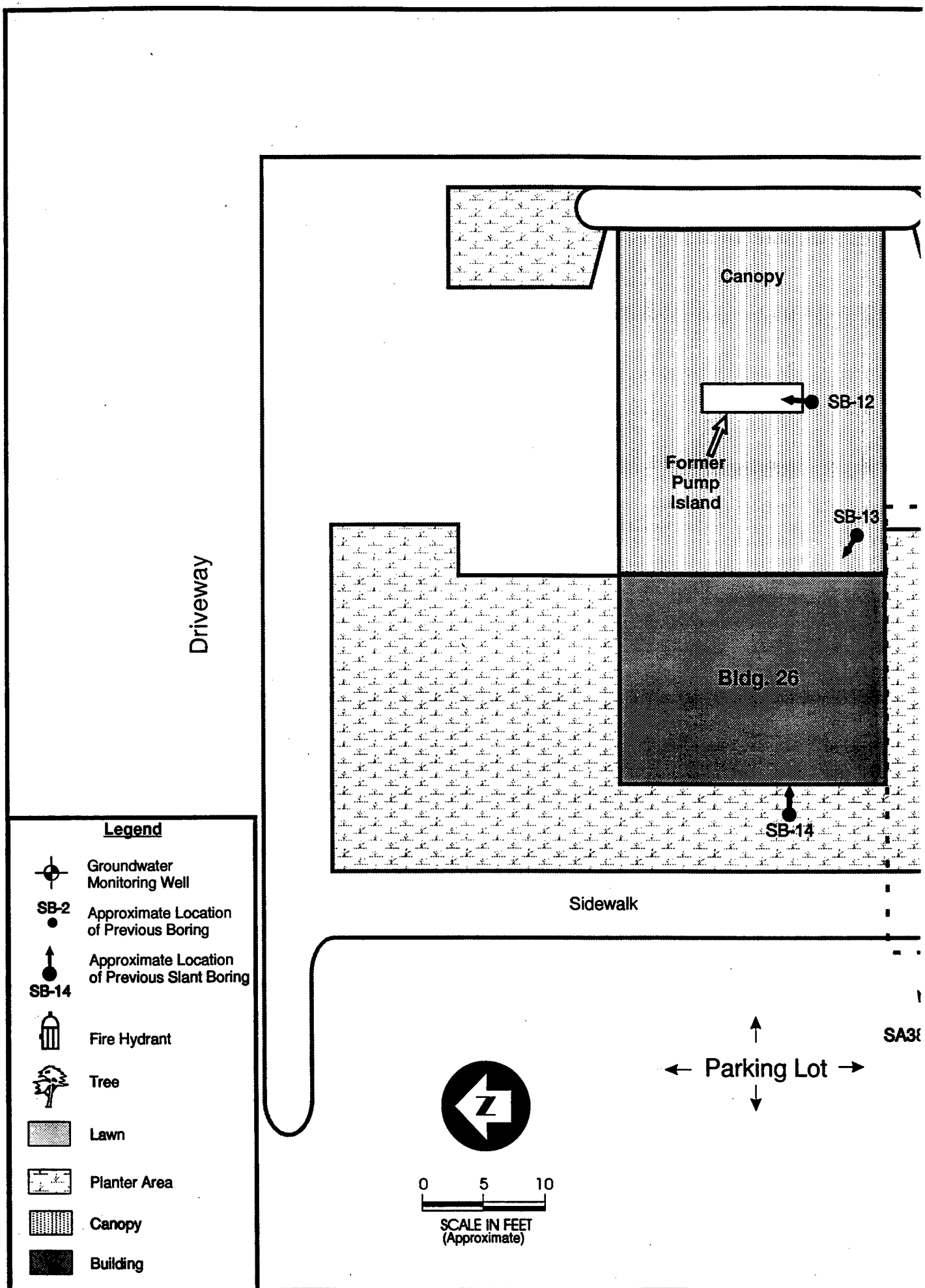
APPROXIMATE BOUNDARIES OF OPERABLE UNITS AND LOCATION OF ST200

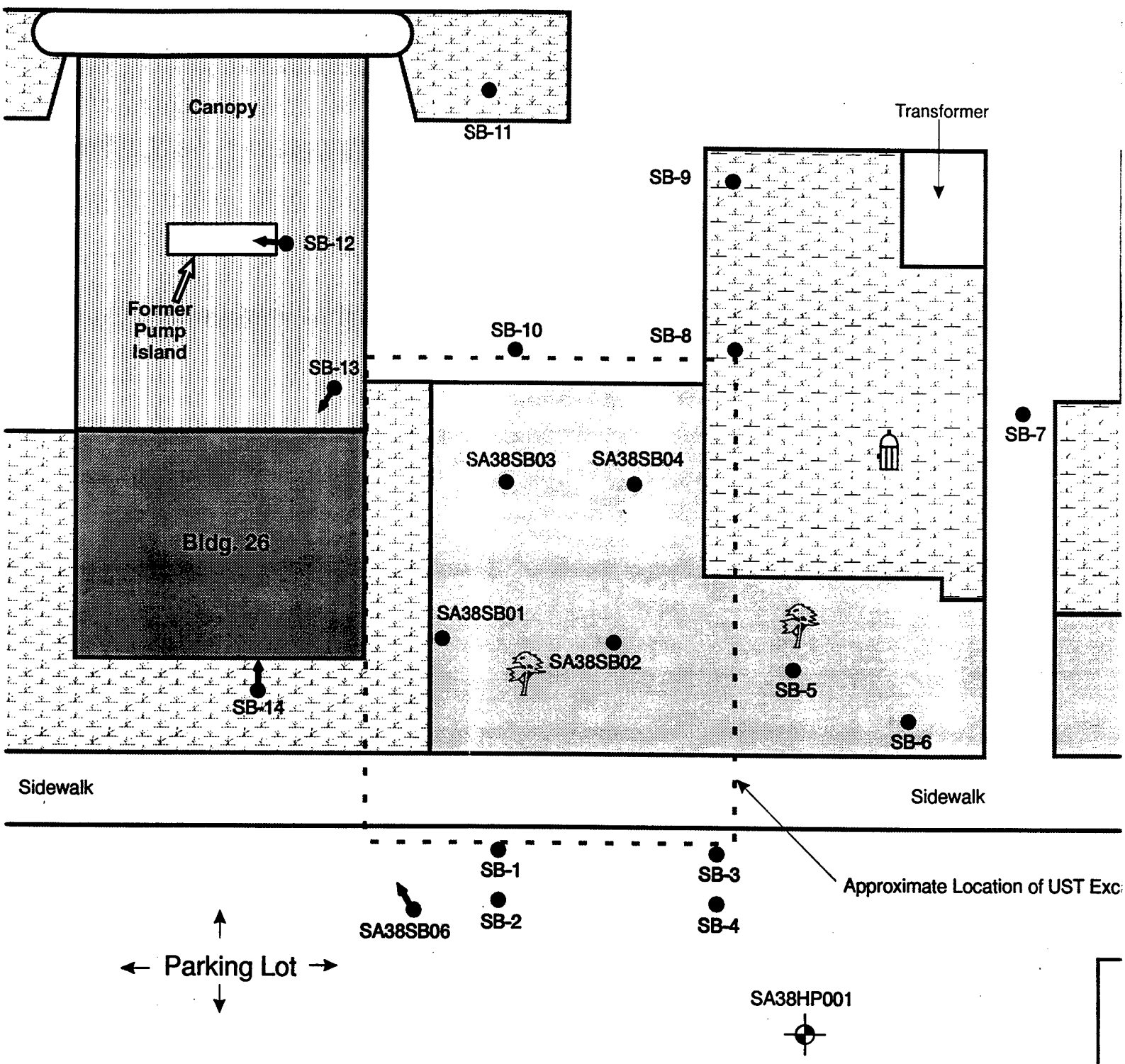
McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.

Oakland, California

MCC11-02.CDR 3/14/97


Canopy
SB-12
Former
Pump
Island
SB-13
Driveway
Bldg. 26
SB-14
Sidewalk
Parking Lot
Legend
Groundwater
Monitoring Well
SB-2
Approximate Location
of Previous Boring
Approximate Location
of Previous Slant Boring
SB-14
Fire Hydrant
Tree
Lawn
Planter Area
Canopy
Building
0
5
10
SCALE IN FEET
(Approximate)


Arnold Avenue
Canopy
SB-11
Transformer
SB-9
SB-12
Former
Pump
Island
SB-10
SB-8
SB-13
SB-7
SA38SB03
SA38SB04
Bldg. 26
SA38SB01
SA38SB02
SB-5
SB-14
SB-6
Sidewalk
Sidewalk
SB-1
SB-3
Approximate Location of UST Exc
SA38SB06
SB-2
SB-4
Parking Lot
SA38HP001

ue

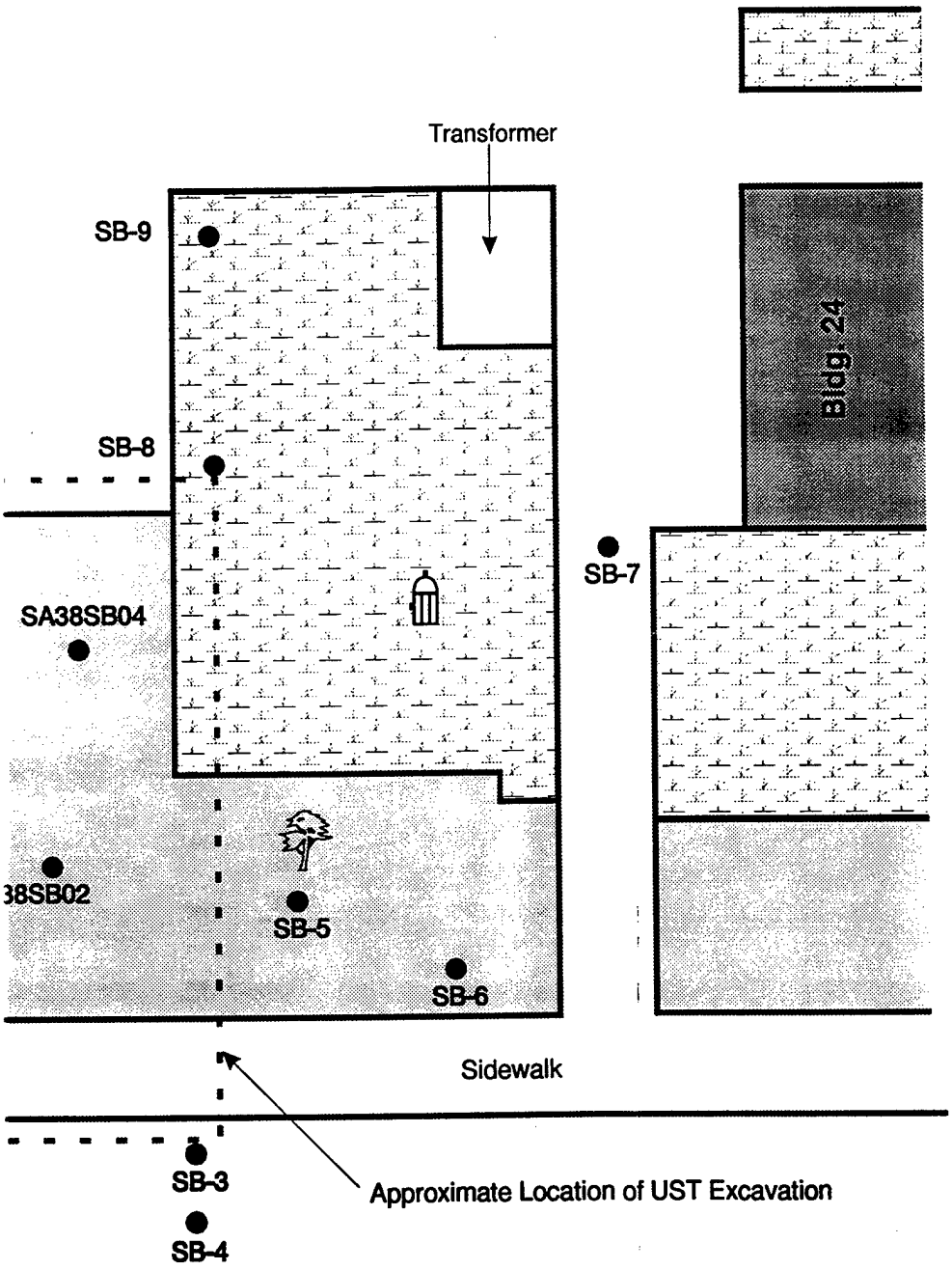


FIGURE 2.3

SITE PLAN and PREVIOUS SAMPLING LOCATIONS SITE ST200

McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.

Oakland, California

currently houses various administrative departments, but was a motor pool from 1939 to 1972. Both Building 24 and Building 26 were built using concrete slab-on-grade construction. Building 26 and the surrounding areas have been designated for preservation as a historic site.

The automobile service station (Building 26) operated from 1940 to approximately 1990 (Jacobs Engineering Group [JEG], 1995). From 1940 to 1980 fuel was stored in two 5,000-gallon underground storage tanks (USTs). In 1980 these USTs were removed and replaced with one 5,000-gallon diesel UST and one 10,000-gallon unleaded gasoline UST. The USTs were located adjacent to the south side of Building 26 and the fuel island was located between the east side of Building 26 and Arnold Avenue. During precision leak tests in 1987, both USTs were found to be leaking at the gaskets that joined the manways (AEMC, 1987). After replacing the manway gaskets, the USTs tested "tight". The tanks and associated piping and pumps were removed in November 1990. During removal of the USTs, soil contamination was observed in the excavation pit and beneath Building 26.

2.2 GEOLOGY AND HYDROGEOLOGY

2.2.1 McClellan AFB Geology and Hydrogeology

McClellan AFB is situated within the Sacramento Valley, a deep trough of sediments primarily derived from weathering of the Sierra Nevada mountains and transported by numerous tributaries to the meandering Sacramento River. The valley is covered by alluvial and fluvial deposits, which were frequently eroded and redeposited by local streams. Meandering and abandonment of stream channels has produced complex regional as well as local stratigraphy dominated by lenses of material with little lateral or vertical continuity. Regionally, soils are mostly fine-grained, but approximately 25 to 30 percent of the deposits are sand and gravel. Soils in the vicinity of the base are extremely variable, but are generally classified as fine, sandy loams. These soils have low shrink-swell potential and generally low soil permeabilities, varying locally.

The alternating layers of channels, overbank deposits, backwater deposits, sand bars, and widespread flood deposits today form an aquifer system that is extremely variable over short distances, but broadly interconnected. This aquifer system has been separated into a series of zones for purposes of groundwater monitoring, and are designated A though E, from shallowest to deepest. Within OU A, the water table is typically between 100 and 125 feet below ground surface (bgs) (JEG, 1995). Within the last ten years, the water table has been steadily declining at a rate between 1.25 and 2.0 feet per year due to over drafting by irrigation, supply, and extraction wells.

A contaminant smear zone of residual liquid and gaseous phase contaminants (primarily chlorinated aliphatic hydrocarbons) exists in the lower vadose zone at contaminated sites throughout McClellan AFB due to changes in flow direction and the declining water table (JEG, 1995). As groundwater levels declined, contaminants have re-partitioned to the vadose zone as gases and some contaminants have remained adsorbed onto soil particles.

The aquifer zones are not hydraulically independent and groundwater can flow vertically between them. Horizontal groundwater movement in each zone is generally in a south-southwest direction, toward a regional pumping depression south of Sacramento. South and west of McClellan AFB numerous active private and public water supply wells influence the immediate subregional groundwater flow; therefore, groundwater flow directions on the base are dependent on location. The groundwater extraction systems installed at McClellan AFB during the 1980s also exert some local hydraulic control in the shallow aquifer zones.

2.2.2 ST200 Geology and Hydrogeology

Site geology has been interpreted from borings SA38SB01 through SA38SB04 and SB38SB06, which were advanced at ST200 during the Basewide Remedial Investigation (RI) conducted in 1993 and in 1996 (JEG, 1995; JEG, 1996). The total depth of these borings ranged from 95.5 to 97 feet below ground surface (bgs). Figure 2.3 shows the previous sampling locations and Appendix A contains copies of the boring logs.

Site soils are typical of the fluvial deposits found throughout OU A and consist of primarily heterogeneous and discontinuous layers of silt and fine sand. The typical subsurface profile within the former UST excavation at ST200 is characterized by gravel fill (excavation backfill) in the upper 14 feet and interbeds of primarily silt and fine sand between 14 and 97 feet below ground surface (bgs). Outside of the former UST excavation the upper 14 feet of soil also consists of sand and silt interbeds. At 50 feet bgs, an approximately 15-foot thick sand zone is encountered which extends throughout IC25.

Groundwater is encountered at approximately 110 feet bgs beneath IC25 and is expected to flow west/southwest (JEG, 1995). Sample location SA38HP001 was converted to a groundwater monitoring well or piezometer in late 1996, but groundwater level data was not available by the date of this Work Plan.

Hydraulic testing was performed on A-zone monitoring well MW-210, located approximately 350 feet northwest of the ST200 (Radian, 1992). The hydraulic conductivity was estimated to be 2 ft/day with a seepage velocity of 0.03 ft/day (11 ft/year), reflecting the relatively low permeability and flat hydraulic gradient of the A-monitoring zone near ST200.

2.3 PREVIOUS INVESTIGATIONS AT ST200

2.3.1 UST Removal and Initial Site Investigations

During tank removal operations in November 1990 three soil samples (A-South, B-South, and C-North) were taken from the bottom of the excavation pit, at approximately 11 feet bgs (County of Sacramento, 1990). Exact locations for the samples were not available and, therefore, are not shown on Figure 2.3. Soil samples were analyzed for total petroleum hydrocarbons (TPH), total recoverable petroleum hydrocarbons (TRPH), purgeable aromatics including benzene, toluene, ethylbenzene, and total xylenes (BTEX), halogenated volatile organic compounds (VOCs), and metals. No halogenated VOCs were detected.

The analytical results for TPH and BTEX are listed in Table 2.1. All three samples contained detectable concentrations of petroleum hydrocarbons except benzene. Benzene was not

detected in any of the three samples. The maximum detected concentrations were: 2,400 mg/kg TPH as gasoline (TPH-g), 5,950 mg/kg TPH as diesel (TPH-d), 367 mg/kg TPH as motor oil (TPH-mo), 9,310 mg/kg TRPH, 0.120 mg/kg toluene, 0.474 mg/kg ethylbenzene, and 9.46 mg/kg total xylenes. The maximum concentrations of TPH-g, TPH-mo, and the BTEX components were detected in sample A-South. The maximum concentrations of TPH-d and TRPH were detected in sample C-North (presumably located nearest Building 26). During removal operations, soil contamination appeared to extend beneath Building 26. The analytical laboratory reported that the fuel pattern for samples with detectable concentrations of TPH-g did not match their gasoline standard. This notation and the relatively low BTEX concentrations compared to TPH-g concentrations suggests some degree of weathering has occurred.

In March 1991, 14 borings (SB-1 through SB-14) were advanced to depths of 10 to 20 feet in and around the UST excavation pit (Figure 2.3). Soil samples were collected from some of the borings and analyzed for TPH and organic lead (Table 2.1). TPH-g and TPH-d were detected in borings SB-12, SB-13, and SB-14. SB-13 and SB-14 were slant borings (40° from vertical) advanced beneath or very close to Building 26. SB-12 was a slant boring advanced beneath the former pump island. Maximum concentrations of 6,410 mg/kg TPH-g, 3,060 mg/kg TPH-d, and 0.07 mg/kg organic lead were detected in boring SB-13 at a depth of 2 feet.

In May 1991, the UST excavation was enlarged until the sidewalls were flush with borings SB-1, SB-3, SB-8, and SB-10 and the base was at 13 feet bgs (Figure 2.3). Prior to backfilling, soil samples A-13, B-13, C-13, and D-13 (locations not reported) were collected from the base of the excavation and analyzed for TPH (Table 2.1). Maximum concentrations of 1,850 mg/kg TPH-g and 621 mg/kg TPH-d were detected in the floor of the excavation.

2.3.2 Phase I Remedial Investigation

The Phase I RI at OU A was conducted between 1992 to 1995 (JEG, 1995). During the RI investigation, four borings were advanced to a depth of 97 feet bgs through the former UST excavation at ST200. Soil and soil vapor samples were collected from the 4 borings, designated SA38SB01 through SA38SB04 (Figure 2.3). Soil samples were collected from depths of approximately 15, 20, 30, 40, 60, 80, and 95 feet bgs for TPH, BTEX, organic lead, and moisture analysis. Downhole soil vapor samples were collected from depths of approximately 12, 22, 42, 62, 82, and 97 feet bgs and analyzed for aromatic and halogenated VOCs. The soil and soil vapor samples analytical results are presented in Tables 2.2 through 2.5.

Residual soil contaminants were primarily concentrated between approximately 15 and 30 feet bgs in the four borings (Table 2.2). The maximum TPH-g concentration (5,900 mg/kg) and maximum total BTEX concentration (203 mg/kg) were detected in SA38SB01 at a depth of 15 feet bgs. The maximum TPH-d concentration of 780 mg/kg was detected in boring SA38SB03 at a depth of 15 feet bgs. Benzene (0.011 mg/kg) was only detected in boring SA38SB02 at a depth of 30 feet bgs. Moisture content was measured between 4.6 and 34 percent by weight, with more than 72% of the samples greater than or equal to 15 percent moisture content.

Table 2.1
Soil Analytical Results for Petroleum Hydrocarbons
UST Excavation Pit Samples & Shallow Soil Borings, Site ST200
McClellan AFB, California

				Total Petroleum Hydrocarbons				Purgeable Aromatics			
			Method:	8015 (Mod.)			418.1	8020			
			Analyte:	TPH-g	TPH-d	TPH-mo	TRPH	Benzene	Toluene	Ethyl-benzene	Total Xylenes
Sample Date	Contractor	Sample No.	Depth (bgs)	Concentrations in mg/kg							
Nov-90	McClellan	A-South	11	2,400	1,070	367	2,060	<0.025	0.120	0.474	9.46
		B-South	11	593	<10	<25	75	<0.005	0.006	0.087	0.612
		C-North	11	<5	5,950	<25	9,310	<0.010	0.018	0.147	0.854
Mar-91	McClellan	SB-1	10	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			20	10	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		SB-2	10	<5	<10	118	n.a.	n.a.	n.a.	n.a.	n.a.
			20	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		SB-3	10	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			20	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		SB-5	10	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			15	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			20	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		SB-8	10	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			20	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		SB-9	10	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			20	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		SB-10	10	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			20	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		SB-11	10	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			20	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		SB-12	6	<5	47	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			10	3,900	611	<50	n.a.	n.a.	n.a.	n.a.	n.a.
		SB-13	2	6,410	3,060	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			8	3,330	405	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		SB-14	5	1,400	91	<25	n.a.	n.a.	n.a.	n.a.	n.a.
			10	2,670	<20	<50	n.a.	n.a.	n.a.	n.a.	n.a.
May-91	McClellan	A 13	13	<5	<10	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		B 13	13	<5	621	<25	n.a.	n.a.	n.a.	n.a.	n.a.
		C 13	13	201	36	27	n.a.	n.a.	n.a.	n.a.	n.a.
		D 13	13	1,850	280	<25	n.a.	n.a.	n.a.	n.a.	n.a.

<12 : Below given reporting limit
n.a. : Not Analyzed
TPH-g : Total Petroleum Hydrocarbons as gasoline
TPH-d : Total Petroleum Hydrocarbons as diesel
TPH-mo : Total Petroleum Hydrocarbons as motor oil
TRPH : Total Recoverable Petroleum Hydrocarbons

Table 2.2
Soil Analytical Results for Petroleum Hydrocarbons
Deep Soil Borings, Site ST200
McClellan AFB, California

				Total Petroleum Hydrocarbons [1]		Purgeable Aromatics [1]			
			Method:	8015 (Mod.)		8020			
			Analyte:	TPH-g	TPH-d	Benzene	Toluene	Ethyl-benzene	Total Xylenes
Sample Date	Contractor	Boring No.	Depth (bgs)	Concentrations in mg/kg					
May-93	Jacobs Engineering Group	SA38SB01	15	5,900	330	ND	4.8	28	170
			20	1,200	320	ND	ND	13	69
			30	440	260	ND	0.83	5.1	27
			40	0.43	ND	ND	ND	ND	0.026
			60	ND	ND	ND	ND	ND	ND
			80	ND	ND	ND	ND	ND	ND
			95	ND	ND	ND	ND	ND	ND
		SA38SB02	15	0.26	ND	ND	ND	ND	ND
			20	0.25	ND	ND	ND	ND	ND
			30	4,400	ND	0.011	ND	44	ND
			40	0.93	ND	ND	ND	0.043	0.16
			60	ND	ND	ND	ND	ND	ND
			80	ND	ND	ND	ND	ND	ND
			95	ND	ND	ND	ND	ND	ND
		SA38SB03	15	2,900	780	ND	ND	9.9	21
			20	4.2	ND	ND	ND	ND	ND
			30	ND	420	ND	ND	ND	ND
			40	0.38	ND	ND	ND	ND	0.021
			60	ND	ND	ND	ND	ND	ND
			80	ND	ND	ND	ND	ND	ND
			95	ND	ND	ND	ND	ND	ND
		SA38SB04	15	n.a.	ND	ND	ND	ND	ND
			20	n.a.	140	ND	ND	ND	ND
			30	n.a.	290	ND	ND	ND	ND
			40	ND	ND	ND	ND	ND	ND
			60	ND	ND	ND	ND	ND	ND
			80	ND	ND	ND	ND	ND	ND
			95	ND	ND	ND	ND	ND	ND
Oct-96	Jacobs Engineering Group	SA38SB06	10	ND	n.a	n.a.	n.a.	n.a.	n.a.
			20	ND	n.a	n.a.	n.a.	n.a.	n.a.
			40	0.33	n.a	n.a.	n.a.	n.a.	n.a.
			70	0.17	170	ND	ND	ND	ND
			90	ND	9	ND	ND	ND	ND
		SA38HP001	10	ND	n.a.	n.a.	n.a.	n.a.	n.a.
			20	ND	n.a.	n.a.	n.a.	n.a.	n.a.
			40	ND	n.a.	n.a.	n.a.	n.a.	n.a.
			60	ND	n.a.	n.a.	n.a.	n.a.	n.a.
			80	ND	n.a.	n.a.	n.a.	n.a.	n.a.
			100	ND	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. : Not Analyzed
ND : Not detected at or above the reporting limit

TPH-g : Total Petroleum Hydrocarbons as gasoline
TPH-d : Total Petroleum Hydrocarbons as diesel

[1] The results from SA38SB06 and SA38HP001 are preliminary.

Table 2.3
Soil Vapor Analytical Results for BTEX
Downhole Samples, Site ST200
McClellan AFB, California

				Aromatic Hydrocarbons [1]			
			Method:	E18/TO-14 [2]			
			Analyte:	Benzene	Toluene	Ethyl-benzene	Total Xylenes
Sample Date	Contractor	Boring No.	Depth [3] (bgs)	Concentrations in ppmv			
May-93	Jacobs Engineering Group	SA38SB01	12	ND	ND	ND	8.5
			22	ND	ND	ND	160
			42	ND	ND	ND	55
			62	ND	4.0	ND	26
			82	ND	2.7	ND	44
			97	ND	ND	ND	9.7
		SA38SB02	12	ND	ND	ND	0.078
			22	ND	ND	ND	2.5
			42	ND	ND	ND	106
			62	ND	20	ND	12
			82	ND	4.5	ND	17
			97	ND	ND	ND	39
		SA38SB03	12	ND	ND	ND	0.19
			22	44	12	ND	130
			42	33	28	ND	130
			62	ND	ND	ND	27
			82	2.9	4.2	ND	39
			97	ND	ND	ND	8.2
		SA38SB04	12	ND	ND	ND	0.073
			22	ND	8.7	ND	28
			42	4.2	4.6	ND	70
			62	4.4	6.4	ND	4.8
			82	ND	1.6	ND	3.4
			97	0.42	0.84	0.98	4.4
Oct-96	Jacobs Engineering Group	SA38SB06	21	0.0099	0.016	ND	0.49
			40	34	19	130	420
			60	0.78	0.74	12	50
			78	0.26	0.54	11	50
			92	0.14	0.39	6.5	28
		SA38HP001	20	0.0069	0.0087	0.0014	0.0050
			40	0.0062	0.0078	ND	0.0029
			60	0.0065	0.0088	0.0014	0.0058
			80	0.0086	0.013	0.0030	0.0070
			100	0.0055	0.0090	ND	0.0026

n.a. : Not Analyzed
ND : Not detected at or above the reporting limit

Notes:

[1] Some of the data was qualified. Refer to RI report for data qualifiers (JEG, 1995). The results from SA38SB06 and SA38HP001 are preliminary.

[2] The sample taken from SA38SB04 at 97 ft bgs was analyzed by both Methods E18 and TO-14; the maximum concentrations are reported.

[3] Boring SA38SB06 was installed 18 degrees from vertical. The corrected depths are shown.

Table 2.4
Soil Vapor Analytical Results for Other Petroleum Hydrocarbons
Downhole Samples, Site ST200
McClellan AFB, California

			Volatile Organic Compounds [1]											
		Method:	E18/TO-14 [2]											
		Analyte:	1,2,4-trimethyl-benzene	1,3,5-trimethyl-benzene	1,3-butadiene	heptane	cyclo-hexane	hexane	MTBE	n-octane	2,4-dimethyl-pentane	2,2,4-trimethyl-pentane	2,3,4-trimethyl-pentane	Propene
Sample Date	Boring No.	Depth [3] (bgs)	Concentrations in ppmv											
May-93	SA38SB04	97	5.6	2.3	0.063	ND	ND	n.a.	ND	5.1	ND	ND	ND	0.83
	SA38SB06	21	0.25	0.53	n.a.	0.21	0.073	ND	ND	n.a.	ND	ND	2.10	0.51
		40	58	29	n.a.	370	41	51	ND	n.a.	ND	ND	ND	ND
		60	14	6	n.a.	16	1.1	1.0	ND	n.a.	ND	ND	ND	ND
		78	22	8.4	n.a.	110	0.4	0.3	ND	n.a.	ND	ND	ND	ND
		92	11	4.3	n.a.	5.3	0.3	0.1	ND	n.a.	ND	ND	ND	ND
Oct-96	SA38HP001	20	0.0014	0.0015	n.a.	0.0060	0.0025	0.0066	0.0033	n.a.	0.0052	0.0073	0.0022	0.25
		40	ND	ND	n.a.	0.0052	ND	0.010	0.0013	n.a.	0.0084	0.0088	0.0019	0.36
		60	0.0012	ND	n.a.	0.0074	ND	0.0080	0.0014	n.a.	0.0073	0.0081	0.0021	0.16
		80	0.0016	ND	n.a.	0.017	0.0026	0.030	ND	n.a.	0.0076	0.012	0.0028	0.93
		100	ND	ND	n.a.	0.010	0.0079	0.017	ND	n.a.	ND	0.008	0.0022	0.33

n.a. : Not Analyzed
ND : Not detected at or above the reporting limit

MTBE : Methyl Tertiary Butyl Ether

Notes:

[1] Some of the data was qualified. Refer to RI report for data qualifiers (JEG, 1995). BTEX results shown in Table 2.3. The results from SA38SB06 and SA38HP001 are preliminary.

[2] The sample taken from SA38SB04 at 97 ft bgs was analyzed by both Methods E18 and TO-14; the maximum concentrations are reported.

[3] Boring SA38SB06 was installed 18 degrees from vertical. The corrected depths are shown.

Table 2.5
Soil Vapor Analytical Results for HVOCs and Other VOCs
Downhole Samples, Site ST200
McClellan AFB, California

			Halogenated Volatile Organic Compounds [1]														Other VOCs 1	
		Method:	E18/TO-14 [2]														E18/TO-14 [2]	
		Analyte:	CCl_4	Chloro-methane	Chloro-form	1,2-DCA	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Freon-11	Freon-12	Freon-113	MeCl	PCE	TCE	VC	Acetone	2-butanone
Sample Date	Boring No.	Depth [3] (bgs)	Concentrations in ppmv															
May-93	SA38SB01	12	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	ND	ND	ND	n.a.	n.a.
		22	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	ND	ND	ND	n.a.	n.a.
		42	ND	n.a.	ND	n.a.	20	34	ND	n.a.	ND	ND	n.a.	ND	ND	4.9	n.a.	n.a.
		62	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	ND	ND	ND	n.a.	n.a.
		82	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	0.33	ND	n.a.	ND	ND	ND	n.a.	n.a.
		97	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	0.78	0.49	ND	n.a.	n.a.
	SA38SB02	12	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	0.051	0.014	ND	n.a.	n.a.
		22	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	0.020	0.012	ND	n.a.	n.a.
		42	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	2.0	1.2	ND	n.a.	n.a.
		62	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	ND	ND	9.1	n.a.	n.a.
		82	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	ND	ND	ND	n.a.	n.a.
		97	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	0.27	ND	n.a.	0.330	ND	ND	n.a.	n.a.
	SA38SB03	12	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	0.0077	n.a.	0.054	0.017	ND	n.a.	n.a.
		22	ND	n.a.	ND	n.a.	ND	34	16	n.a.	ND	ND	n.a.	3.8	ND	ND	n.a.	n.a.
		42	ND	n.a.	ND	n.a.	ND	21	ND	n.a.	ND	ND	n.a.	3.8	ND	ND	n.a.	n.a.
		62	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	0.81	0.48	ND	n.a.	n.a.
		82	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	0.78	0.40	6.6	n.a.	n.a.
		97	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	0.76	ND	ND	n.a.	n.a.
	SA38SB04	12	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	0.035	0.013	ND	n.a.	n.a.
		22	ND	n.a.	0.34	n.a.	5.8	ND	ND	n.a.	ND	ND	n.a.	ND	ND	ND	n.a.	n.a.
		42	ND	n.a.	ND	n.a.	ND	ND	2.4	n.a.	ND	ND	n.a.	0.94	0.47	4.8	n.a.	n.a.
		62	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	ND	ND	ND	n.a.	n.a.
		82	ND	n.a.	ND	n.a.	ND	ND	ND	n.a.	ND	ND	n.a.	0.10	ND	0.99	n.a.	n.a.
		97	0.28	ND	0.033	0.17	ND	ND	ND	0.11	0.26	0.032	ND	0.12	0.063	0.70	0.16	ND
Oct-96	SA38SB06	21	ND	ND	ND	ND	0.013	ND	ND	0.030	ND	ND	ND	0.033	ND	ND	0.33	ND
		40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		78	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		92	0.18	ND	ND	ND	ND	ND	ND	0.11	ND	0.066	ND	ND	ND	ND	ND	ND
	SA38HP001	20	0.0065	ND	0.0014	ND	ND	ND	ND	0.15	0.0088	0.0049	ND	0.0068	ND	ND	0.067	0.0062
		40	0.061	ND	0.0075	ND	ND	ND	ND	0.22	0.041	0.030	ND	0.036	0.36	ND	0.036	ND
		60	0.073	0.0080	0.0072	ND	ND	ND	ND	0.13	0.062	0.045	ND	0.036	0.26	ND	0.077	0.017
		80	0.28	0.026	0.025	0.038	ND	ND	ND	0.28	0.14	0.099	ND	0.087	0.28	ND	0.092	ND
		100	0.45	0.013	0.066	0.060	ND	ND	ND	0.38	0.21	0.13	0.0047	0.11	0.18	ND	0.057	0.010

n.a. : Not Analyzed
ND : Not detected at or above the reporting limit

DCE : dichloroethene
DCA : dichloroethane

CCl_4 : carbon tetrachloride
MECl : methylene chloride

VC : vinyl chloride
PCE : tetrachloroethene

Notes:

[1] Some of the data was qualified. Refer to RI report for data qualifiers (JEG, 1995).
The results from SA38SB06 and SA38HP001 are preliminary.

[2] The sample taken from SA38SB04 at 97 ft bgs was analyzed by both Methods E18 and TO-14; the maximum concentrations are reported.

[3] Boring SA38SB06 was installed 18 degrees from vertical. The corrected depths are shown.

The downhole soil vapor analytical results for BTEX compounds and other petroleum hydrocarbon related compounds are shown in Tables 2.3 and 2.4. Although at least one of the BTEX or petroleum hydrocarbon related compounds were detected in all samples, concentrations were generally highest in the samples collected from 22 and 42 feet bgs, consistent with the analytical results for soil samples. The maximum detected BTEX concentrations during the Phase I RI sampling were: 44 part per million by volume (ppmv) benzene, 28 ppmv toluene, 0.98 ppmv ethylbenzene, and 130 ppmv total xylenes. Concentrations generally showed a decreasing trend with depth.

Halogenated VOCs and non-petroleum hydrocarbon VOCs were also detected in downhole soil vapor samples (Table 2.5). The maximum concentrations of halogenated VOCs measured at concentrations greater than 1.0 ppmv were: 3.8 ppmv PCE, 1.2 ppmv TCE, 20 ppmv 1,1-DCE, 34 ppmv cis-1,2-DCE, 16 ppmv trans-1,2-DCE, and 9.1 ppmv vinyl chloride. Concentrations were generally highest in the samples collected from 22 and 42 feet bgs, where the highest concentrations of petroleum hydrocarbons were measured in soil and soil vapor samples. However, no sources of halogenated VOCs have been attributed to Site ST200. The compounds with the highest concentrations (1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride) are potential anaerobic biodegradation daughter products of TCE, PCE, and carbon tetrachloride and the vadose zone soils near the petroleum hydrocarbon contamination are probably anoxic. Therefore, the detection of these compounds at the shallower depths is likely a result of the dehalorespiration of low concentration soil residuals or migrating soil vapor, rather than an indication of a significant vadose zone source of halogenated VOCs.

Of the detected halogenated VOCs, PCE, 1,1-DCE, and cis-1,2-DCE were identified in the RI as chemicals of potential concern (COPC) due to migration of soil gas contaminants to groundwater (JEG, 1995).

2.3.3 Additional Site Characterization Activities

In late 1996, additional site characterization activities were conducted based on the Phase I RI report recommendations for ST200 (JEG, 1996). Two borings, SA38SB06 and SA38HP001, were advanced at the site. SA38SB06 was a slant boring advanced beneath the west side of Building 26 and SA38HP001 was a vertical boring advanced southwest of the former UST excavation (Figure 2.3). Soil and soil vapor samples were collected at approximately 20-foot intervals to a depth of 100 feet bgs. Soil samples were analyzed for TPH-g, TPH-d, BTEX, metals, and organic lead. Soil vapor samples were analyzed for VOCs. Boring SA38HP001 was advanced to groundwater and a Hydropunch® groundwater sample was collected for laboratory analysis. Analytical results from the additional sampling activities are included in Tables 2.2 through 2.5; however, all results from SA38SB06 and SA38HP001 are preliminary (JEG, 1996).

Residual soil contamination was detected at greater depths than during earlier subsurface investigations. TPH-g was detected at concentrations of 0.33 mg/kg at 40 feet bgs and 0.17 mg/kg at 70 feet bgs in SA38SB06. TPH-d was detected at concentrations of 170 mg/kg at a depth of 70 feet bgs and 9 mg/kg at a depth 90 feet bgs in SA38SB06. The magnitude of

the maximum concentration for TPH-g was significantly lower in SA38SB06 than in previous soil borings. However, the slant boring was drilled through relatively uncontaminated soil outside the former excavation in the upper depths (less than 60 feet bgs) and only reached impacted soil underneath Building 26 at depths greater than approximately 60 feet bgs.

In soil vapor, the maximum concentration of BTEX compounds measured during the additional sampling activities were: 34 ppmv benzene, 19 ppmv toluene, 130 ppmv ethylbenzene, and 422 ppmv total xylenes (all detected in the sample collected from SA38SB06 at a depth of 42 bgs). Ethylbenzene was detected at significantly higher concentrations during the additional sampling activities than during Phase I RI activities. BTEX concentrations were well below 1.0 ppmv at SA38HP001, which was installed farthest from the source area and primarily located to evaluate downgradient groundwater impacts. The soil vapor results are consistent with the previous soil vapor results during the Phase I RI.

Tables 2.4 and 2.5 present the soil vapor analytical results for other petroleum hydrocarbons and halogenated VOCs for the additional sampling activities. The soil vapor concentrations for the anaerobic biodegradation breakdown products (i.e., TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride) were significantly less than those measured during the Phase I sampling, probably because the vadose zone soils have a higher oxygen content in locations sampled by the additional activities. In addition, the halogenated VOCs generally show an increasing trend with depth, with the highest concentrations generally measured nearest to groundwater.

Halogenated VOCs were the primary contaminants detected in the Hydropunch® groundwater sample (Table 2.6). However, a concentration of 0.037 mg/L TPH-g was also measured. BTEX was not detected in the groundwater sample.

2.3.4 Summary

The primary contaminants attributable to ST200 are petroleum hydrocarbons. Although halogenated VOCs were also detected in soil vapor, none were detected in soil. These detections are likely related to off-gassing from the regional groundwater plume of halogenated VOCs, from adjacent sites SA37 and SA39, or from residuals within the groundwater smear zone (JEG, 1995). During removal of the USTs, hydrocarbon contamination was observed beneath Building 26 and beneath the excavation pit. Soil and soil vapor sampling at ST200 has confirmed that the area immediately adjacent to and beneath Building 26 contains the highest concentrations of residual fuel contaminants.

Additional sources of residual fuel contamination may include soils underneath the former UST excavation area, the former fuel island east of Building 26, and the north side of Building 26. Based on previous sampling activities, the vertical and horizontal extent of vadose zone contamination appears to be well-defined except for north side of Building 26. Most of the residual soil contamination appears to be limited to depths between 15 and 40 feet bgs. Groundwater beneath the site has been impacted by halogenated VOCs and TPH-g, but the halogenated VOCs are presumed to originate from off-site sources. Although halogenated VOCs were measured in soil vapor, there does not appear to be a significant

Table 2.6
Groundwater Analytical Results for HVOCs and TPH
Site ST200
McClellan AFB, California

		Halogenated Volatile Organic Compounds [1]								Petroleum Hydrocarbons [1]
	Method:	SW8260A								SW8015M
	Analyte:	CCl4	Chloro-form	1,2-DCA	Freon-11	Freon-12	MeCl	PCE	TCE	TPH-g
Sample Date	Location	Concentrations in µg/L								Concentration in mg/L
Oct-96	SA38HP001	3.3	4.9	2.5	0.73	0.28	0.21	0.58	1.5	0.037

TPH-g : Total Petroleum Hydrocarbons as gasoline
DCA : dichloroethane
CCl_4 : carbon tetrachloride
MECl : methylene chloride
PCE : tetrachloroethene
TCE : trichloroethene

Notes:
[1] Preliminary results.

source of non-petroleum hydrocarbons at the site. Based on the detection of anaerobic dehalorespiration daughter products in soil vapor, there appears to be some anaerobic biodegradation of halogenated VOCs occurring in the vadose zone.

SECTION 3

SITE-SPECIFIC ACTIVITIES

The purpose of this section is to describe the work that will be performed by Parsons ES. Activities that will be performed include siting and construction of up to 2 vent wells (VWs) and up to 5 vapor monitoring points (VMPs), an initial pilot test (including *in situ* respiration tests and an air permeability test), and installation of a long-term bioventing system. Soil and soil vapor sampling procedures and the blower configuration that will be used to introduce air (oxygen) into contaminated soils are also discussed in this section.

Subsurface soils are expected to be composed of mostly interbedded sands and silts which should be suitable for the bioventing technology. Soil moisture data (Section 2.3.2) indicate that the subsurface soils contain sufficient moisture to sustain some degree of respiration and biodegradation. Based on previous bioventing pilot tests conducted at McClellan AFB, soils are expected to contain sufficient nutrient levels; however, these levels will be measured during initial soil sampling.

No dewatering or groundwater treatment will take place during the pilot testing. Pilot test activities will be confined to remediation of petroleum hydrocarbons in vadose zone soils.

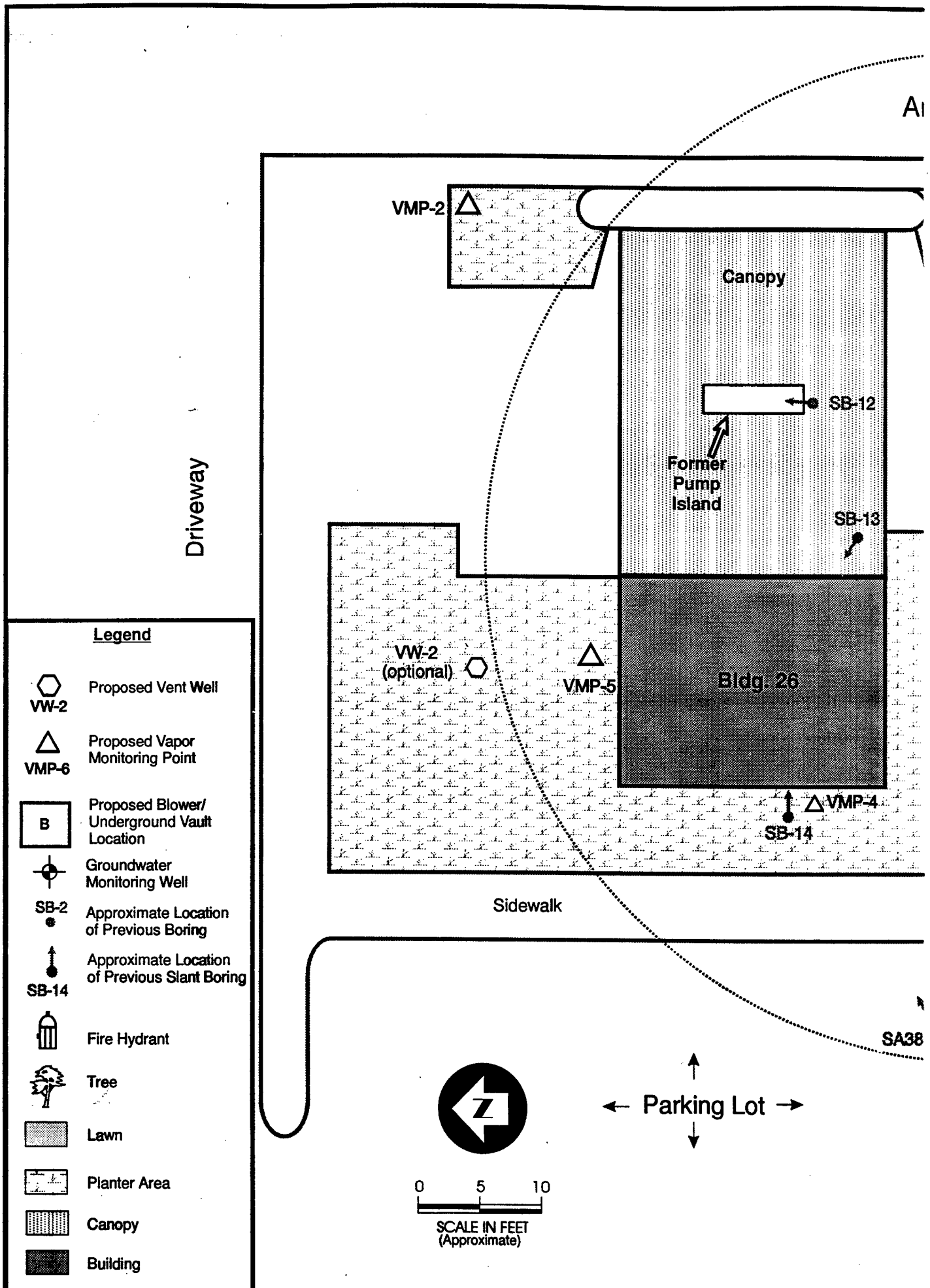
3.1 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

To achieve all quality assurance/quality control (QA/QC) objectives, all site-specific activities will follow the standard operating procedures (SOPs) described in the Basewide RI/FS Quality Assurance Plan (QAP) for McClellan AFB (McClellan AFB, 1994) unless specific exceptions or variations to the SOPs are noted in the following sections. Additional QA/QC objectives specific to bioventing operations are detailed in the Program Quality Assurance Project Plan for AFCEE Bioventing Pilot Tests (ES, 1993).

3.2 LOCATIONS OF VENT WELLS (VWS) AND VAPOR MONITORING POINTS (VMPS)

Based on the previous site investigation data (Section 3), the area immediately adjacent to and beneath Building 26 contains the highest concentrations of residual fuel contaminants. Additional sources of residual fuel contamination may include soils underneath the former UST excavation area, the former fuel island east of Building 26, and the north side of Building 26.

General criteria used for siting VWs and VMPs are included in the protocol documents (Hinchee at al., 1992; Leeson and Hinchee, 1995). Figure 3.1 shows the proposed locations



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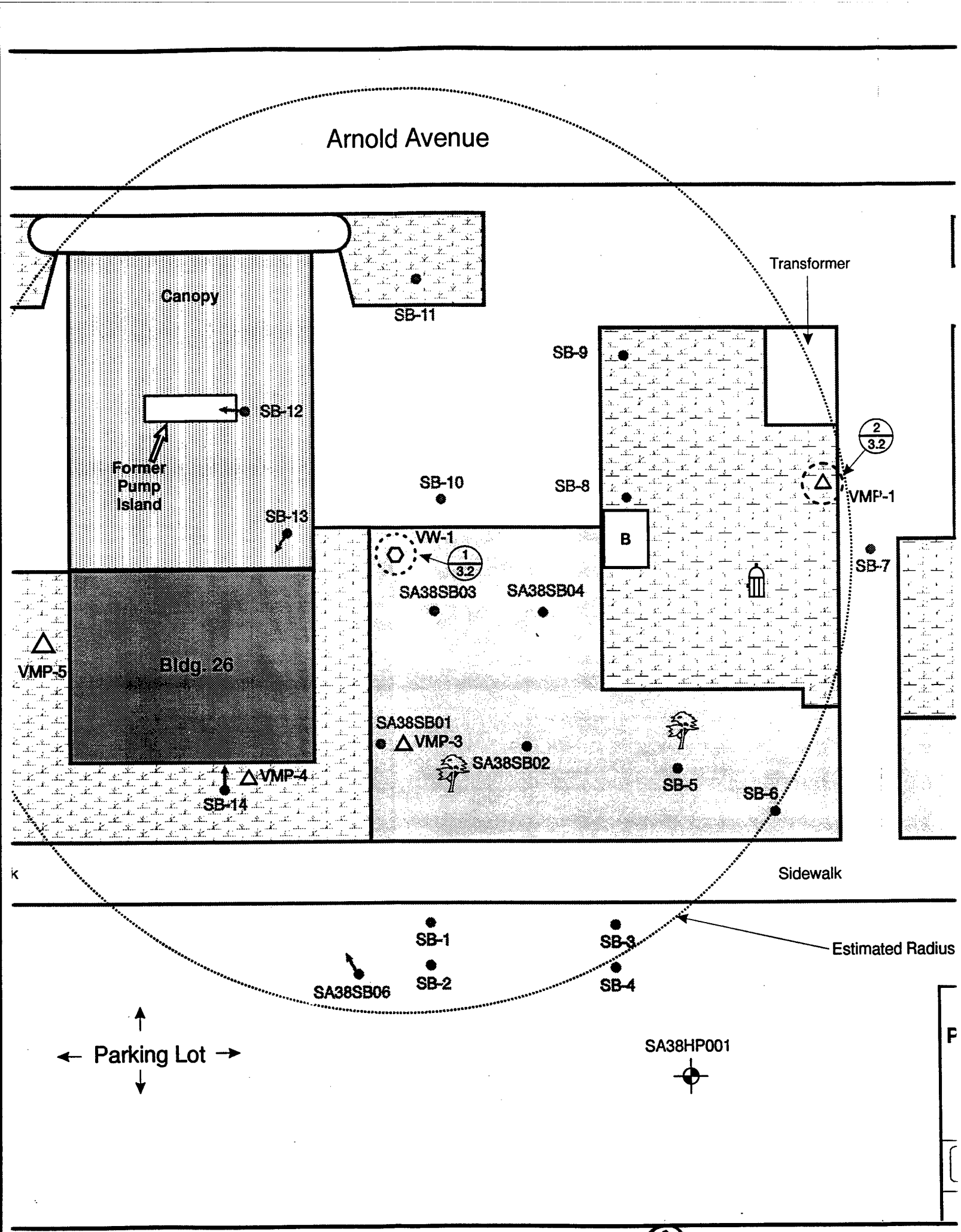

Arnold Avenue
Canopy
SB-11
Transformer
SB-9
SB-12
Former
Pump
Island
SB-10
SB-8
2
3.2
VMP-1
SB-13
VW-1
1
3.2
B
SB-7
SA38SB03
SA38SB04
VMP-5
Bldg. 26
SA38SB01
VMP-3
SA38SB02
SB-5
SB-6
VMP-4
SB-14
Sidewalk
SB-1
SB-3
Estimated Radius
SA38SB06
SB-2
SB-4
Parking Lot
SA38HP001

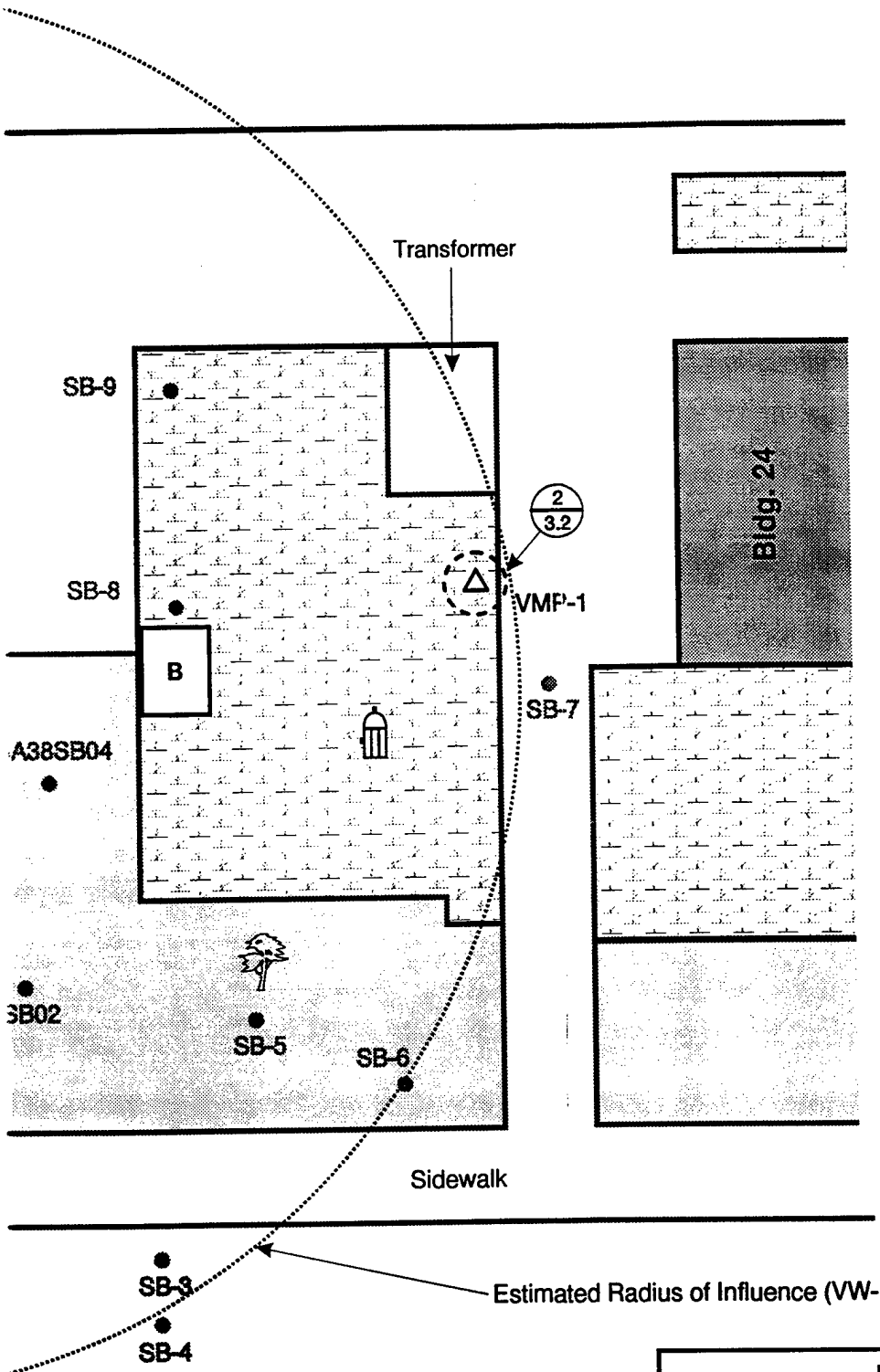


FIGURE 3.1

PROPOSED VENT WELL AND VAPOR MONITORING POINT LOCATIONS SITE ST200

McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.

Oakland, California

of the VW(s) and VMPs. The proposed location of VW-1 is on the southeast side of Building 26. This location for VW-1 was chosen so that the treatment radius from VW-1 would encompass all the known areas of soil contamination, but minimize the potential for contaminant vapors to migrate toward Building 24, which is currently occupied.

The proposed location for VW-1 and the expected treatment radius of 40 to 50 feet should be sufficient to remediate all contaminated soil underneath the former UST excavation, Building 26, and the former fuel island. The estimated treatment radius of 40 to 50 feet based on the composition of the soils at ST200 and based on bioventing pilot tests performed at other Base sites. An optional VW, designated VW-2, may be installed if field evidence of contamination is detected on the north side of Building 26 (i.e., during installation of VMP-5) or if the treatment radius measured during the AP test indicates that the treatment radius does not encompass known contaminated soils.

Up to a total of 5 VMPs will be located within the expected radius of influence from VW-1. All VMPs will be used to measure pressure response during bioventing operations and used to estimate the treatment radius from the VW(s). At the request of McClellan AFB, all VW(s) and VMPs were located within planter box or grass areas to preserve the integrity of the site and maintain the historical nature of the Building. Therefore, VMPs were not located beneath the former pump island or underneath the canopy.

The location of VMP-1 was chosen primarily to monitor potential vapor migration toward Building 24. Based on previous sampling results, this location is not expected to be contaminated. The location of VMP-2 was chosen along the air flow pathway from VW-1 toward the former fuel island to verify that the soils beneath the former pump island are within the treatment area. Pressure response and changes in soil vapor concentration in both VMP-2 and other VMPs will be used to infer that soils underneath the former fuel island are within the treatment area.

The locations of VMP-3, VMP-4, and VMP-5 were chosen within or immediately adjacent to areas of known contamination and will be the primary VMPs where soil and soil vapor sampling and *in situ* respiration (ISR) tests will be conducted. The location of VMP-5 was chosen to evaluate the horizontal extent of contamination on the north side of Building 26.

The final locations of the VW(s) and VMPs may vary from the proposed locations if evidence of significant fuel contamination is not observed where expected (i.e., VW-1, VMP-3, and VMP-4) or if significant fuel contamination is observed in unexpected areas (i.e., north of Building 26). The VW(s) will be located so that the treatment radius encompasses areas of fuel contamination which are also expected to be oxygen depleted (less than 5%). Increased biological activity should be stimulated by oxygen-rich soil gas ventilation during both the initial pilot test and long-term air injection operations.

3.3 BOREHOLE ADVANCEMENT AND SAMPLE COLLECTION

Boreholes will be advanced using a hollow stem auger (HSA) drill rig equipped with 8-inch and 10-inch outside-diameter (OD) hollow-stem augers. The 10-inch augers will be used to advance the pilot hole for the VW and the 8-inch augers will be used for VMPs. Soil

samples will be collected every 5 feet for logging purposes and at significant lithologic changes. Soil samples will be collected in a 2-inch inside-diameter (ID) split-barrel sampler. The split-barrel sampler was fitted with three pre-cleaned, 2-inch OD by 6-inch long, thin-walled, stainless steel or brass sleeves.

Due to the extensive downhole soil vapor sampling previously conducted at the site, no downhole soil vapor sampling is proposed during drilling and installation of the VW(s) and VMPs for the bioventing system. However, *in situ* soil vapor samples will be collected from the new VW and VMPs, as described in Section 3.6.

3.4 CONSTRUCTION OF VENT WELL(S) (VWS)

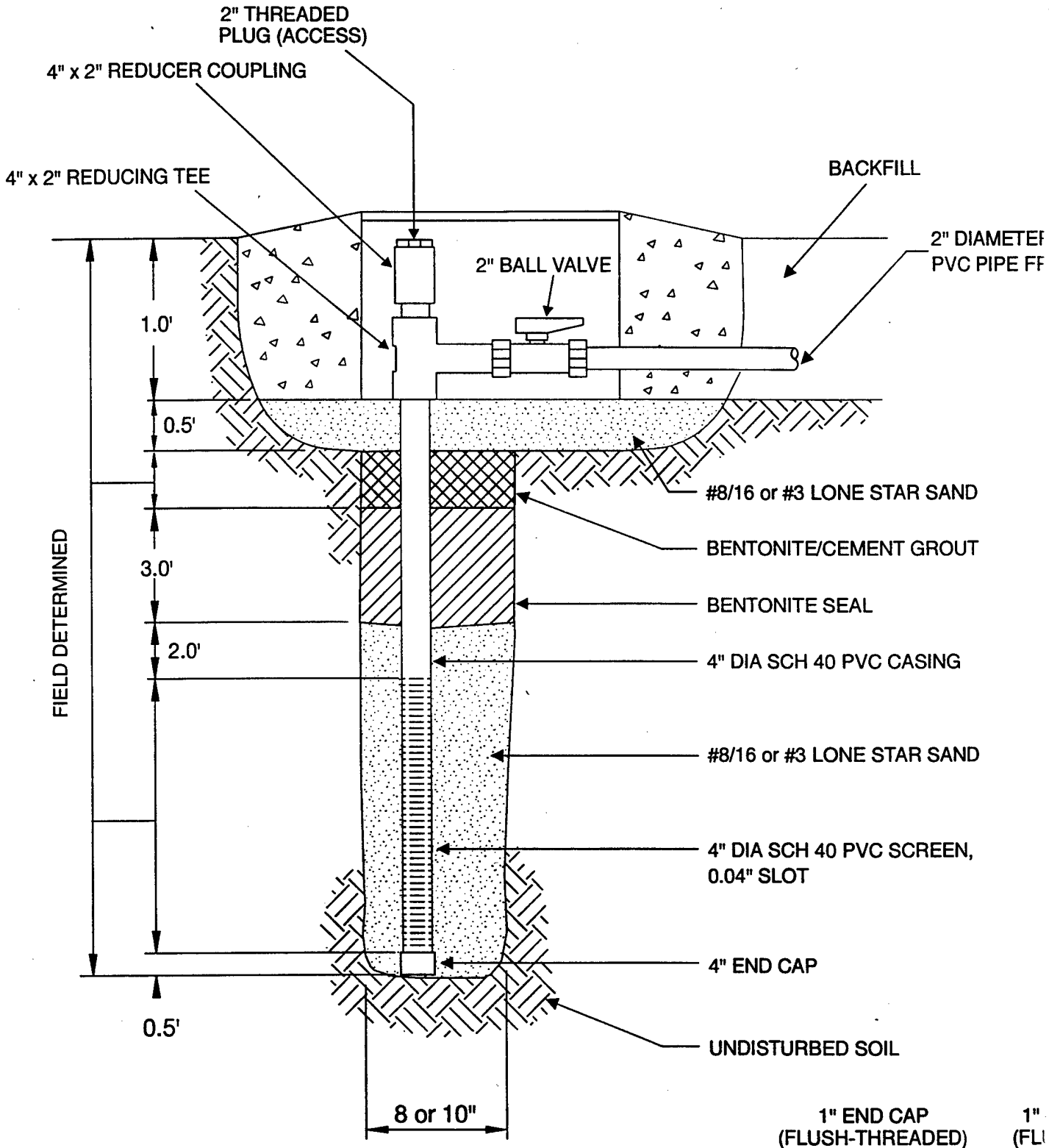
Figure 3.2 shows construction details for the proposed VW(s). The VWs will be constructed of 4-inch inside diameter (ID) Schedule 40 polyvinyl chloride (PVC) casing, with an interval of 0.040-inch slotted screen. The screened interval will be between the initially encountered contamination (but a minimum of 5 feet bgs) down to the base of contamination as determined by field organic vapor analysis (OVA) of soil sample head space. The top of the screen interval may be set lower than the uppermost zone of soil contamination to prevent short-circuiting of injected air within any near-surface zone of high permeability (e.g., the former excavation backfill material).

The depth selected as the base of contamination will be based on an evaluation of physical and visual evidence of contamination (e.g. odors and staining), site lithology, as well as headspace screening using both a total volatile hydrocarbon analyzer (TVHA) and a photoionization detector (PID). The TVHA is a platinum catalyst combustion detector calibrated with hexane, which provides a conservative reading representative of total petroleum hydrocarbon vapors present. Two to three additional headspace readings will be taken at increasing depths beyond the apparent end of contamination to ensure that the vertical extent of contamination has been delineated. Based on previous soil borings and soil vapor monitoring, it is estimated that the maximum depth of the VWs will be between 40 and 60 feet bgs.

Flush-threaded PVC casing and screen will be used with no organic solvents or glues. The filter pack will be a clean Lone Star sand with a #8/16 or #3 grain size and will be placed in the annular space of the screened interval. A 3-foot layer of bentonite will be placed directly over the filter pack. The remainder of the annular space, except for a 2-foot open area directly below the ground surface, will be filled with a bentonite/cement grout. A complete seal is critical to prevent the short-circuiting of air from the surface during air injection. Additional details on VW construction are found in Section 4 (Hinchee et al., 1992) and Volume II, Section 2.5 (Leeson and Hinchee, 1995) of the protocol documents.

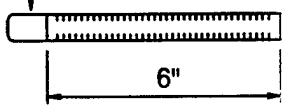
3.5 CONSTRUCTION OF VAPOR MONITORING POINTS (VMPS)

Figure 3.2 shows the construction detail for the proposed VMPs. The VMPs will be constructed of 0.50-inch ID, Schedule 80 PVC casing and 1-inch ID slotted screen intervals (0.020-inch slot size). Flush threaded PVC casing and screen will be used with no organic



1" END CAP
(FLUSH-THREADED)

1"
(FL



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VENT WELL DETAIL

NOT TO SCALE

3
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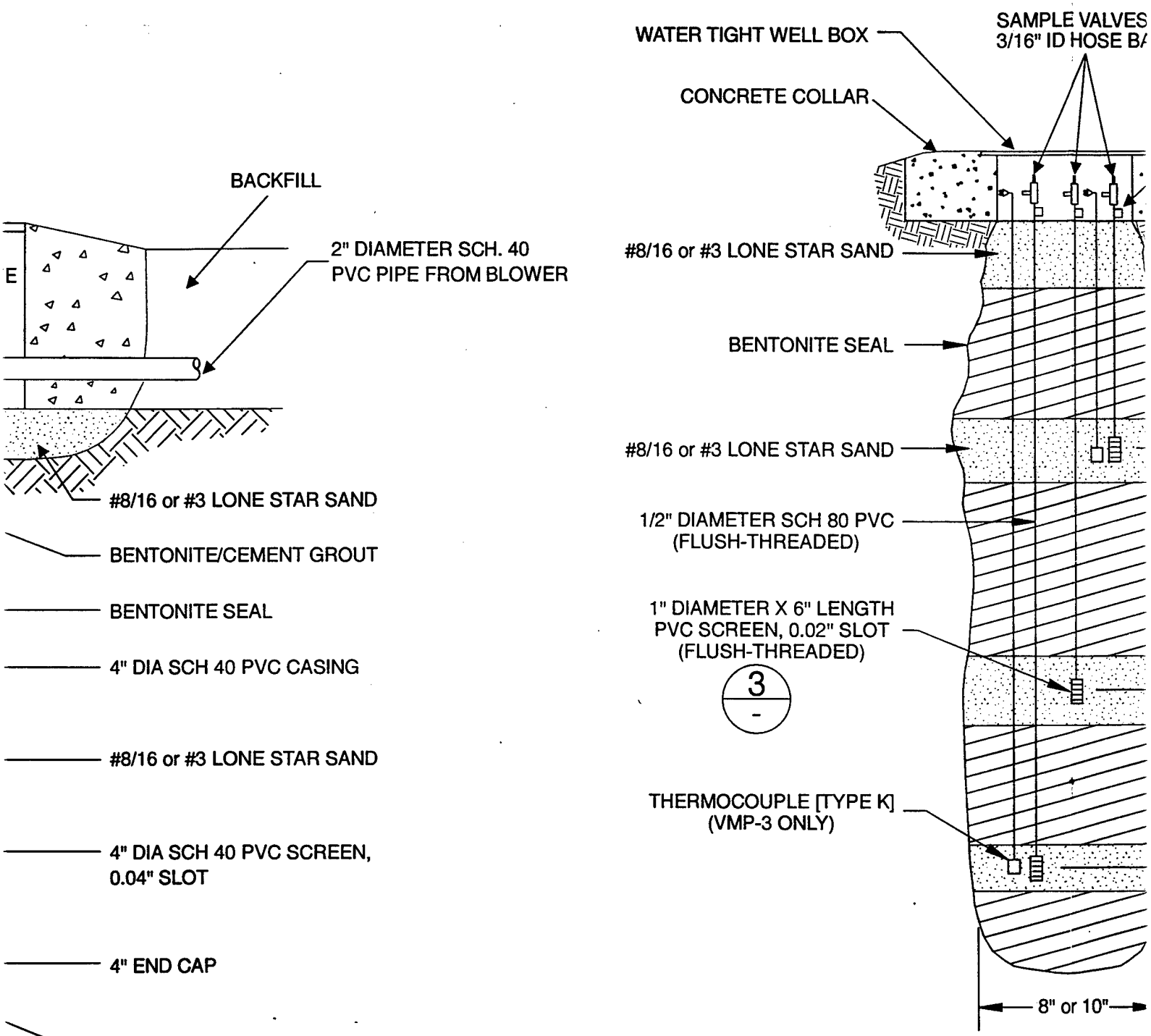

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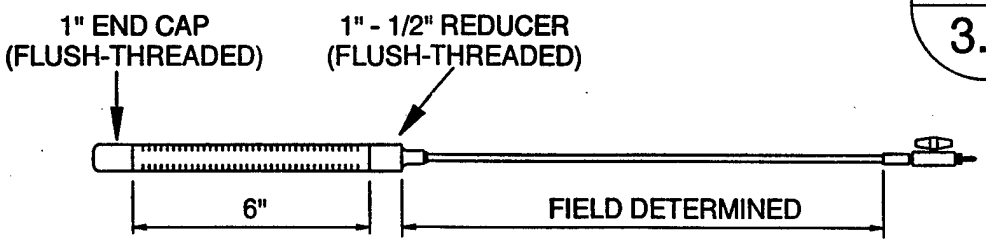

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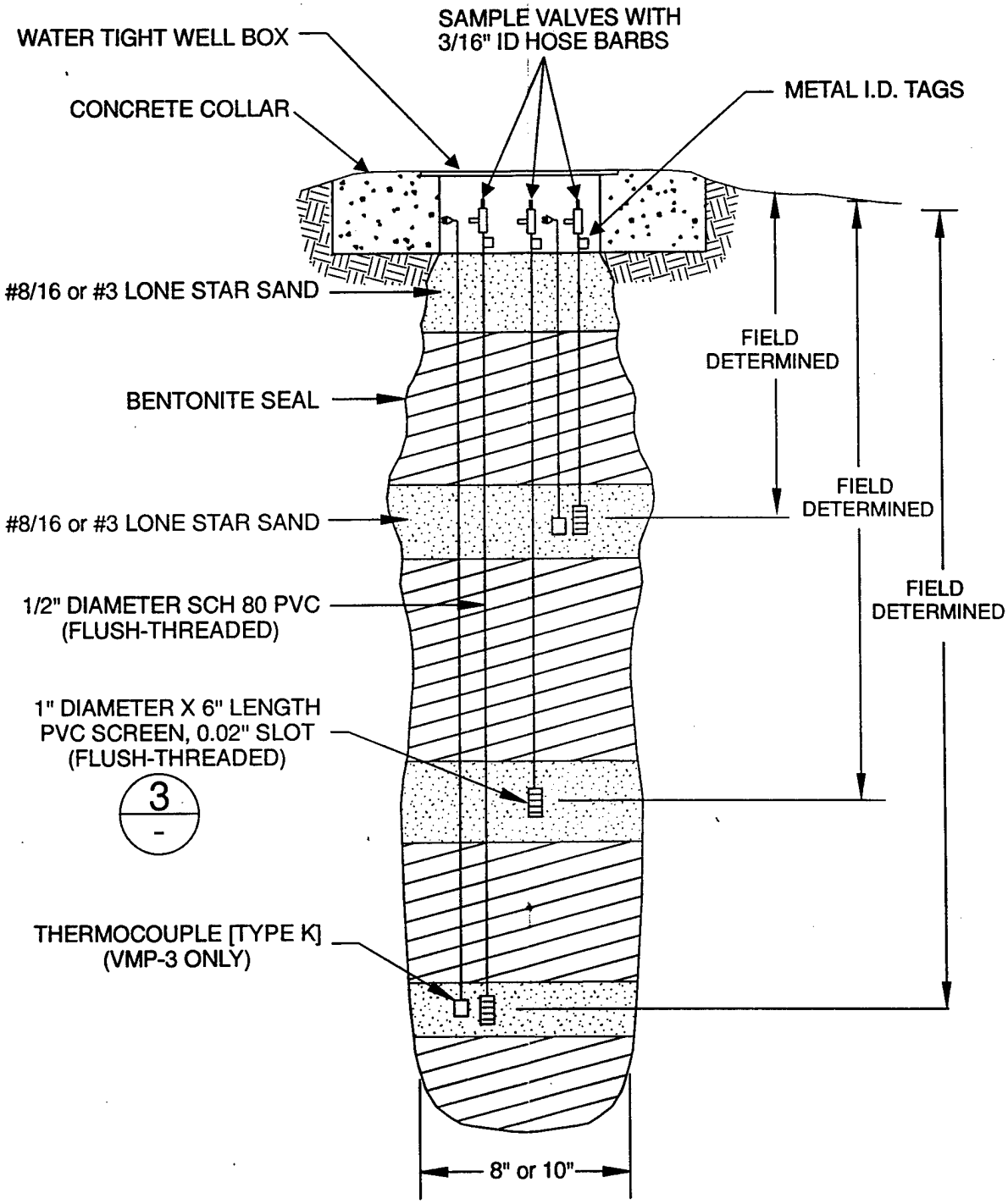

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3.1

VAPOR MONITORING POINT DETAIL

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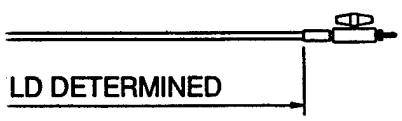

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FIGURE 3.2

CONSTRUCTION DETAILS FOR PROPOSED VWs AND VMPs

McClellan AFB, California

PARSONS ENGINEERING SCIENCE, INC.

Oakland, California

solvents or glues. The annular space between the vapor monitoring screen filter packs will be sealed with a bentonite seal to isolate the monitoring intervals.

The VMPs will be screened to a maximum of three depths. Depths will be selected which provide good vertical coverage between the ground surface and the base of contamination and through different soil types. Multi-depth monitoring will determine the concentration of oxygen across the entire soil profile and will be used to calculate oxygen-utilization rates and fuel biodegradation rates at all monitored depths. The deepest screen will be placed at or near the bottom of contamination as determined by field instrumentation. Oxygen and carbon dioxide concentrations in soil vapor will be monitored using these vapor monitoring screens. Additional details on VMP construction are found in Section 4 (Hinchee et al., 1992) and Volume II, Section 2.6 (Leeson and Hinchee, 1995) of the protocol documents. The VMP construction in the protocol documents varies slightly from SOP McAFB-006 on construction of vapor piezometer nests; however, the VMPs are designed for low-pressure bioventing operations rather than high-vacuum soil vapor extraction (SVE) operations and the differences are not expected to be significant.

3.6 SOIL AND SOIL VAPOR SAMPLING

3.6.1 Soil Sampling

At least one soil sample for laboratory analysis will be collected from the borings advanced prior to installation of VW-1, VMP-3, VMP-4, and VMP-5. During prior investigations, contaminated soils were identified in these locations and the vertical extent of contamination was previously delineated. Therefore, the primary purpose of soil sample collection from these borings will be to establish baseline conditions prior to bioventing and to supplement previous analytical sampling with additional information on nutrient conditions (e.g., phosphorus, nitrogen, and iron).

No soil sampling for laboratory analysis is planned for VMP-1 or VMP-2 since these locations are expected to be in uncontaminated areas and are located primarily to evaluate vapor migration and the treatment radius. At the discretion of the field team leader, soil samples for laboratory analysis may be collected from VMP-1 and/or VMP-2 or additional samples may be collected from the other borings to characterize the depth and extent of contamination, especially if contamination appears to be more extensive than encountered during previous investigations.

Soil samples will be collected using a split-spoon sampler containing brass tube liners. Soil samples collected in the brass tubes will be immediately trimmed and the ends sealed with Teflon® fabric held in place by plastic caps. Soil samples collected for inorganic and physical parameters analysis will be collected in brass tubes or placed in other appropriate sample containers. Soil samples will be labeled, wrapped in plastic, and placed in an ice chest for shipment. A completed chain-of-custody record form will accompany the ice chest, which will be shipped for analysis to Inchcape Testing Services Inc., San Jose, California, which has been audited by the U.S. Air Force and which meets all QA/QC and certification requirements for the State of California.

All soil samples will be analyzed for total TPH as gasoline and diesel (SW8015 Modified); BTEX (SW8020); and moisture content (ASTM D2216). At the request of local regulatory agencies, all samples with detectable concentrations of total TPH will also be analyzed for soluble TPH using deionized water extraction (California Title 22, DI-WET Method). Up to 4 soil samples from both contaminated and uncontaminated locations will be analyzed for pH (SW9045), total alkalinity (Standard Method 403); total iron (SW7380), total Kjeldahl nitrogen (USEPA 351.2), and total phosphorus (USEPA 365.3) to establish baseline and background geochemical and nutrient conditions. Up to two soil samples from uncontaminated soils will be analyzed for total organic carbon (TOC) (SW9060) to support any future vadose zone modeling activities necessary to achieve No Further Investigation (NFI) status.

3.6.2 Soil Vapor Sampling

A maximum of six soil vapor samples for laboratory analysis will be collected in Summa™ canisters from the VW(s) and the VMPs which will be installed in contaminated soils (i.e., VMP-3, VMP-4, and VMP-5). Soil vapor samples for laboratory analysis will not be collected from the VMPs installed in uncontaminated soils (i.e., VMP-1 and VMP-2); these VMPs will be used primarily to monitor pressure response, oxygen influence, and potential vapor migration using field instruments. However, at the discretion of the field team leader, additional samples may be collected from locations which are significantly contaminated and/or oxygen-deficient based on field readings. All soil vapor samples collected for laboratory analysis will be analyzed for BTEX and TVH using EPA Method TO-3. Soil vapor samples will be used to establish baseline conditions and used in the future to determine the reduction in contaminant concentrations over time. Soil vapor samples from all VWs and VMPs will be collected for field analysis of oxygen, carbon dioxide, TVH (using the TVHA), and ionizable compounds (using a PID).

Soil vapor samples will be packed to prevent excessive movement during shipment. They will be sent at ambient temperature to prevent condensation of hydrocarbons. A completed chain-of-custody record will accompany the samples, which will be shipped to Air Toxics Ltd. in Folsom, California, which meets all required U.S. Air Force and State of California certification requirements.

3.7 HANDLING OF INVESTIGATION DERIVED WASTES AND EQUIPMENT DECONTAMINATION

Drill cuttings and decontamination fluids will be containerized on site in labeled U.S. DOT-approved 55-gallon drums. Transportation, characterization, and disposal of IDW will be performed by Base personnel. Equipment decontamination procedures will follow the QAP SOPs, with the exception that isopropanol may be substituted for methanol during decontamination of downhole equipment.

3.8 *IN SITU* RESPIRATION TESTS

In situ respiration (ISR) tests will be performed after collection of baseline soil vapor samples and prior to any air permeability testing or blower operations. The objective of the ISR tests

is to determine the rate at which native soil microorganisms will biodegrade contamination in site soils.

ISR tests will be performed at the VMPs where biodegradation is indicated by initially low oxygen levels and elevated carbon dioxide levels in the soil gas. A mixture of air (20.8 percent oxygen) and 2 to 4 percent helium will be injected into these VMPs for approximately 20 hours to oxygenate local contaminated soils. At the end of the 20-hour period, the air/helium supply will be cut off and oxygen, carbon dioxide, total volatile hydrocarbons (TVH), and helium levels will be monitored for the following 48 to 72 hours. The decline in oxygen levels over time will be used to estimate rates of bacterial degradation of fuel residuals. Helium, an inert gas, will be used as a tracer gas and monitored to identify possible system leaks or short circuits to the surface. Additional details on ISR testing are found in Section 5.7 (Hinchee et al., 1992) and Volume II, Section 1.4 (Leeson and Hinchee, 1995) of the protocol documents.

3.9 AIR PERMEABILITY TESTS

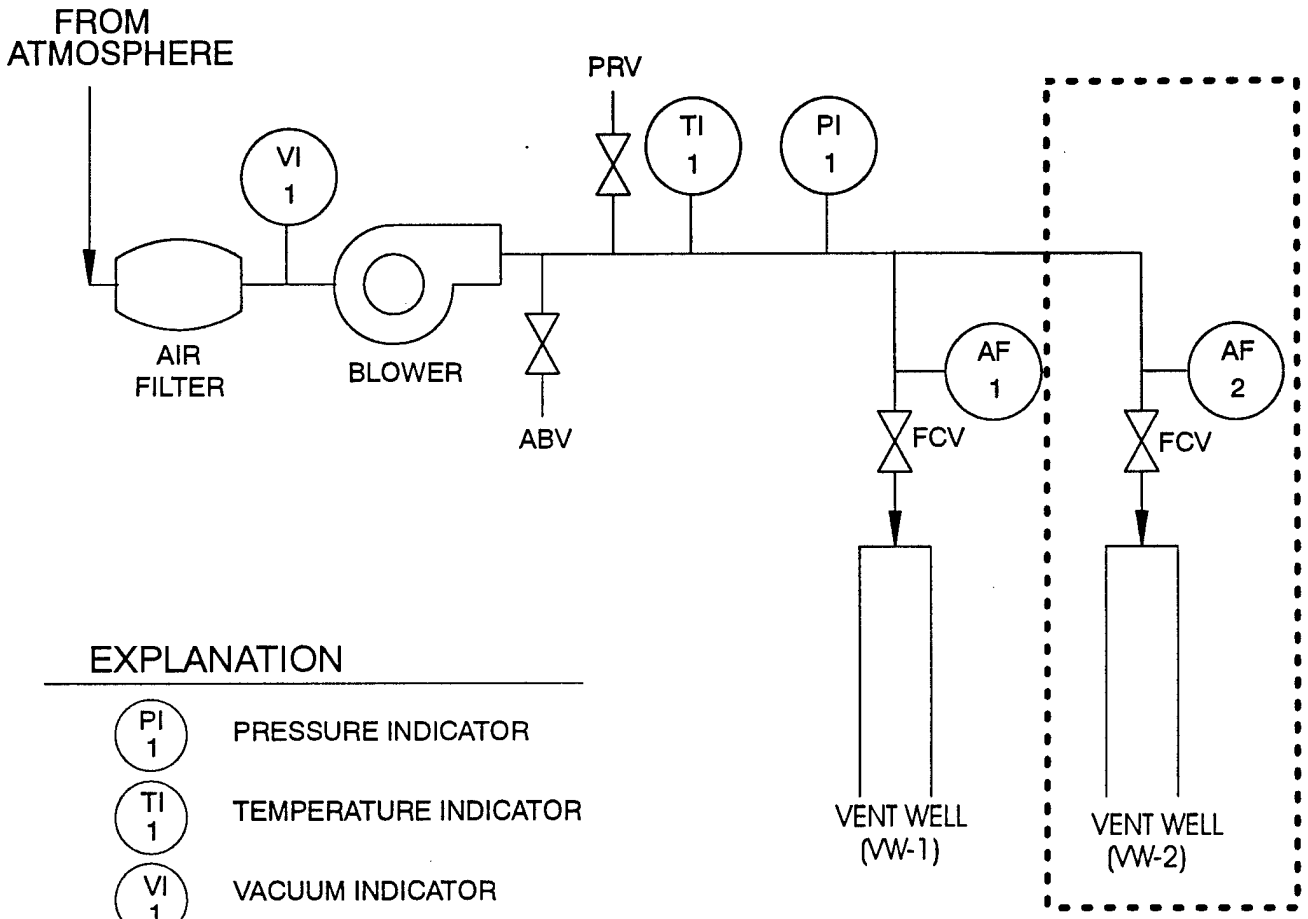
The objective of the air permeability (AP) test is to determine the extent of the subsurface which can be oxygenated from one vent well. Air will be injected into VW-1 using a either a portable blower unit or the blower to be used for long-term air injection operations. Pressure response will be measured at each VMP with differential pressure gauges to determine the region influenced by the blower. Oxygen will also be monitored in the VMPs to evaluate oxygen response as a result of air injection. One AP test lasting approximately 8 hours will be conducted. Additional details on the AP test are found in Section 5.6 (Hinchee et al., 1992) and Volume II, Section 1.5 (Leeson and Hinchee, 1995) of the protocol documents.

3.10 BLOWER SYSTEM

A 1.0-horsepower, regenerative blower capable of injecting air at up to 50 standard cubic feet per minute (scfm) at 40 inches H_2O pressure will be installed for long-term air injection operations. The Gast™ Model R4 blower currently installed at the Tank Farm #4 (PRL T-18) site will be relocated to ST200 for long-term air injection operations. The Tank Farm #4 site has recently been designated for No Further Investigation status from the local regulatory agencies.

At the request of McClellan AFB, to maintain the historic integrity of the site the blower will be installed below ground in a concrete vault. A sump pump with an automatic level control and external shut-off switch will be installed in the vault. The vault, sump pump, and electrical connection to the vault will be installed by Base personnel or their subcontractors. Parsons ES or its electrical subcontractor will perform the final connection between the electrical supply in the vault and the blower. The maximum power requirement anticipated for the blower is 208-volt, single-phase, 30-amp service. Additional details on power supply requirements are described in Section 5.0, Base Support Requirements. Figure 3.3 is a schematic of a typical air injection system.

After blower installation, continuous air injection at low flow rates (equal to or less than one pore volume exchange per day) will commence. The flow rate will be monitored closely and



EXPLANATION

PI 1	PRESSURE INDICATOR
TI 1	TEMPERATURE INDICATOR
VI 1	VACUUM INDICATOR
ABV	AIR BLEED VALVE
PRV	PRESSURE RELIEF VALVE
FCV	FLOW CONTROL VALVE
AF 1	AIR FLOW INDICATOR PORT
	OPTIONAL

FIGURE 3.3

BLOWER PROCESS FLOW AND INSTRUMENTATION DIAGRAM FOR AIR INJECTION

McClellan AFB, California

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Oakland, California

BE400-13.CDR 3/10/97

adjusted so that only enough oxygen will be supplied the meet the demand of the indigenous microorganisms. This operating flow rate will be calculated from the oxygen-utilization rate measured during the initial ISR test.

3.11 MONITORING FOR POTENTIAL VAPOR EMISSIONS

Based on prior bioventing experience at McClellan AFB and bioventing studies conducted nationwide, the contaminant concentrations in soil and soil vapor measured at ST200 do not indicate significant potential for vapor migration into Building 24. VW-1 has been sited in a location which will both minimize potential vapor migration and still meet treatment objectives. Based on the previous soil sampling, contaminated soils are not present between the proposed location of VW-1 and Building 24 or east of VW-1 toward the subsurface utilities which run along Arnold Avenue. Although contaminated soils do exist at the former pump island, the radius of influence is not expected to extend to the subsurface utilities from the former pump island and VMP-2 has been located to monitor for such potential vapor migration. Contaminated soils and soil vapor do exist underneath Building 26; however, McClellan AFB staff have agreed to keep Building 26 unoccupied for the duration of bioventing operations or until it can be shown that the bioventing system operation does not present an undue risk to future Building 26 occupants.

Prior to the start of air injection operations, air monitoring using field instruments (PID and TVHA) will be performed within Building 26, Building 24, and along any accessible subsurface utilities to establish baseline conditions. One ambient air sample in both Building 24 and Building 26 will also be collected in a Summa™ canister and submitted for laboratory analysis by EPA Method TO-14 for VOCs. The sampling will occur after normal business hours, as needed, to avoid disruption of any building occupants.

Within 24 hours after long-term air injection operations are initiated, air monitoring using field instruments will be repeated. If field screening levels are above the previously established baseline conditions, an additional Summa™ canister will be collected for laboratory analysis and the blower will be shutdown pending the results of the laboratory analyses. Sampling within a 24-hour period of system startup is considered conservative since the highest potential for vapor migration will occur shortly after system startup when equilibrium concentrations in soil vapor exist and the initial pore volume of soil vapor is being replaced.

3.12 REPORTING

A pilot test results report will be prepared following initial sampling and testing operations. This report will summarize well construction activities, soil and soil vapor sampling results, and ISR and AP test results. Initial estimates of biodegradation rates for fuel-hydrocarbons will also be discussed and recommendations for future testing and monitoring will be made. The report will include an operations and maintenance (O&M) manual for the blower system. The report format will be similar to that used for previous bioventing pilot tests at other McClellan AFB sites (ES, 1994; Parsons ES, 1996a).

SECTION 4

BASE SUPPORT REQUIREMENTS

The following base support is needed prior to the arrival of a driller and the Parsons ES test team:

- Obtain all necessary regulatory concurrence for well installation, sampling, and pilot test activities;
- Obtain any required digging permits and/or permits needed to install vadose zone wells;
- Construct the subsurface concrete vault to hold the blower, provide 208-volt, 30-amp service for the blower to the inside of the vault, and install the sump pump and controls;
- Coordinate with Base electrical or obtain any needed permission to allow Parsons ES subcontractors to perform electrical hookup of the blower;
- Provide any paperwork required to obtain gate passes and security badges for approximately three Parsons ES employees and one driller. Vehicle passes will be needed for two trucks and a drill rig. The passes must be valid for the expected duration of drilling operations and the initial pilot tests (about one month); and
- Provide staff support and Building 24 and 26 access for the after-hours soil vapor sampling, if needed (see Section 3.11).

During the extended air injection operations, the following additional base support items are recommended:

- Base personnel should check the blower system once each week to ensure that it is operating, change filters as needed, and to record air injection pressures and temperatures. Parsons ES will provide an O&M manual, data collection sheets, and a brief training session, if needed.
- If the blower stops working, notify: Mr. Michael Phelps or Mr. Marcus Pierce, Parsons ES-Oakland, (510) 891-9085. However, under the current contract scope of work, major maintenance or future monitoring activities are the responsibility of McClellan AFB.

SECTION 5

PROJECT SCHEDULE

The following schedule is based on the timing requirements anticipated for regulatory agency reviews and approvals and assumes that this draft Work Plan will be submitted to the regulatory agencies in its current form.

Event	Date
Draft Pilot Test Work Plan to McClellan AFB and AFCEE	19 March 1997
Draft Pilot Test Work Plan to Regulatory Agencies	28 March 1997
Comments due from McClellan AFB, AFCEE, and Regulatory Agencies	23 May 1997
Final Pilot Test Work Plan to McClellan AFB, AFCEE, and Regulatory Agencies	20 June 1997
Begin VW and VMP Construction	7 July 1997
Begin ISR and AP Tests	21 July 1997
Completion of all field activities	25 July 1997
Pilot Test Results Report to McClellan AFB, AFCEE, and Regulatory Agencies	October 1997

SECTION 6

POINTS OF CONTACT

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Michael Phelps, Site Manager
Marcus Pierce, Site Geologist/Health and Safety Officer
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John Ratz, Project Manager
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Fax (303) 831-8208

SECTION 7

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APPENDIX A

BORING LOGS FROM PREVIOUS INVESTIGATIONS AT ST200

LOG OF BORING SA38SB01

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A		AIR FORCE BASE MCCLELLAN AFB	
PROJECT NUMBER: 21G11500	LOCATION IDENTIFIER: SA38SB01	SHEET: 1 of: 9	
thing: 362188.45 Easting: 2175809.20		Elevation and Datum: 80.00 Ft above mean sea level(MSL)	
Health and Safety: Level D with Tyvek		Date Started: 05/17/93	Date Finished: 05/17/93
Drilling Equipment: CME 750		Total Depth(feet): 97.00	Depth to Groundwater(feet): NA
Drilling Method: Hollow Stem Auger		Borehole Diameter: 8.00 inches	
Sampling Method: 18 inch Split-Spoon Sampler		Monitoring/Vapor Extraction Well As-Built Total Depth (Feet): NA In Figure: NA	
Hammer Information: 140 lb with 30 in drop		Logged by: TL	Checked by: KRL KRL

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
0.00	8 15 17	94.00			0.00	GP		GRAVEL: Tank backfill, sand/gravel/minor clay constituents.	
5.00	5 7 9	88.00			0.00	GP		GRAVEL: Tank backfill, sand/gravel/minor clay constituents.	
10.00	12 32 46	88.00		MC-A008949	452.00	ML		SILT: 5Y3/2 dk olv gray, silt w/ minor sand and gravel, sl moist, non pl, dense, strg HC odor.	
15.00	8 29 46	100.00		MC-A008958 MC-A008957 MC-A008891	0.00	ML		SILT: 10YR6/4 lt yllw brown, dry, dense, FeOx stain, strg HC odor	
20.00	12 23 29	100.00		MC-A008959 MC-A008960 MC-A008892 MC-C224301	0.00	SP		SAND: 10YR5/3 brown, subrnd sand, coarsening w/ depth from fn to vry crs, mod graded, moist, md dense,	
25.00									

LOG OF BORING SA38SB01

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21G11500 | LOCATION IDENTIFIER: SA38SB01 | SHEET: 2 of: 4

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
								strg HC odor.	
	11 32 39	100 00			773.00	ML			
30 00				MC-A008861 MC-A008862 MC-A008863		SP		SILT: 2.5Y5/3 lt olv brown, silt w/ minor sand interbeds, dry, non pl, dense, FeOx stain, strg HC odor.	
								SAND: 10YR4/3 dk brown, vry fn to md, mod graded subrnd sand, moist, dense, strg HC odor.	
	8 15 23	100 00			700 00	ML			
35 00								CLAYEY SILT: 2.5Y5/3 lt olv brown, silt w/ app 25% clay, sl moist, low pl, md dense, minor FeOx stain, HC odor.	
	8 15 21	100 00			193.00	SP			
40 00				MC-C224203 MC-C224202 MC-C224201				SAND: 2.5Y5/2 gry brown, vry fn to md, mod graded subrnd sand, moist, md dense, strg HC odor.	
				MC-C224302	445.00				
	6 10 15	100 00			49.00	ML			
45 00								SANDY SILT: 2.5Y5/4 lt olv brown, silt w/ app 25% vry fn to fn sand, moist, non pl, md dense, sl HC odor.	
	10 12 14	100 00			77.00	SP			
50 00								SAND: 10YR4/4 dk yllw brown, fn to md sand w/ minor olv gray silt interbeds, dry, md dense, deep FeOx staining, strg HC odor	
	10 10 20	100 00			43.00	SP			
55 00								SAND 10YR5/3 brown, fn to crs subrnd sand, coarsening w/ depth, dry, loose, sl HC odor	

LOG OF BORING SA38SB01

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21611500 | LOCATION IDENTIFIER: SA38SB01 | SHEET: 3 of: 9

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
55.00									
	13 14 18	100.00			28.00	SP			
60.00				MC-C224206 MC-C224205 MC-C224204				SAND: 10YR3/3 dk brown, fn to md, md graded subrnd sand, dry, md graded, deep FeOx stain (dry and dense silt in shoe).	
				MC-C224303	25.00				
	20 50 0	100.00			3.00	SM		SILTY SAND: 2.5Y4/2 dk gry brown, vry fn to fn sand w/ app 25% silt, sl moist, non pl, dense	
65.00									
	16 25 40	100.00			0.00	ML		SILT: 2.5Y6/3 lt yllw brown, silt w/ thin crs sand interbed at 70.5 feet, dry, dense, minor FeOx stain.	
70.00									
	30 50 0	100.00			0.00	ML		SANDY SILT: 2.5Y4/3 lt olv brown, silt w/ app 20% vry fn to fn sand, dry, dense, minor FeOx stain.	
75.00									
	10 14 36	100.00			3.00	ML		SILT: 2.5Y5/3 lt olv brown, silt w/ minor fn sand interbeds, dry, non pl, dense, minor FeOx stain	
80.00				MC-C224209 MC-C224208 MC-C224207					
				MC-C224304	66.00				
	16 19 25	100.00			0.00	ML		SILT: 2.5Y5/3 lt olv brown, silt w/ md sand interbed at 84.75 feet, dry, non pl, dense, some FeOx stain	
85.00									

LOG OF BORING SA38SB01

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21611500 | LOCATION IDENTIFIER: SA38SB01 | SHEET: 1 of: 1

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
90.00	19 22 27	100.00			0.00	SP		SAND: 10YR6/4 yllw brown, fn to md subrnd sand, dry, md dense, FeOx throughout, sl HC odor.	
95.00	25 50 0	77.00		MC-C226703 MC-C226702 MC-C226701	0.00	ML		SILT: 2.5Y5/4 lt olv brown, sl moist, non pl, dense, hard, some FeOx.	
				MC-C224305	20.00				
100.00									
105.00									
110.00									
115.00									

LOG OF BORING SA38SB02

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A		AIR FORCE BASE MCCLELLAN AFB
PROJECT NUMBER: 21611500	LOCATION IDENTIFIER: SA38SB02	SHEET: 1 of: 9
Northing: 362176.85 Easting: 2175809.17		Elevation and Datum: 80.00 ft above mean sea level(a)
Health and Safety: Level D with Tyvek		Date Started: 05/20/93 / Date Finished: 05/20/93
Drilling Equipment: CME 750		Total Depth(feet): 97.00 / Depth to Groundwater(feet): NA
Drilling Method: Hollow Stem Auger		Borehole Diameter: 8.00 inches
Sampling Method: 18 inch Split-Spoon Sampler		Monitoring/Vapor Extraction Well As-Built Total Depth (Feet): NA / In Figure: NA
Hammer Information: 140 lb with 30 in drop		Logged by: TL / Checked by: KRL KRL

Depth (Feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
0.00									
	12 22 30	100.00			0.00	GP		GRAVEL: sand, clay, gravel to 0.5 inch, tank backfill.	
5.00									
	9 11 17	100.00			0.00	GP		GRAVEL: sand, clay, gravel to 1.0 inch, tank backfill.	
10.00				MC-C228701					
	22 38 46	100.00		MC-C228503 MC-C228502 MC-C228501	14.00	ML		SILT: 2.5Y5/3 lt ol brown, silt w/ app 10% md sand, sl moist, dense, sl HC odor.	
15.00									
	7 33 49	94.00		MC-C228506 MC-C228505 MC-C228504	18.00	ML		SILT: 2.5Y5/3 lt ol brown, dry, dense, hard, FeOx stains.	
20.00				MC-C228702					
	5 17 23	100.00			138.00	ML SP		SILT: 2.5Y5/3 lt olv brown, dry, non pl, dense, FeOx stain SAND: 2.5Y6/3 lt yllw brown, fn to crs md graded subrnd sand, moist, md dense, HC odor, blk discoloration, FeOx stain	
25.00									

LOG OF BORING SA38SB02

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21G11500 | LOCATION IDENTIFIER: SA38SB02 | SHEET: 2 of: 4

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
25.00									
	11 24 41	100.00		MC-C228505 MC-C228506 MC-C228507	277.00	ML SP		SILT: 2.5Y5/3 lt olv brown, dry, non pl, dense, strg HC odor SAND: 2.5Y5/3 lt olv brown, vry fn to fn sand w/ minor clay, moist, dense, cohesive, FeOx stain, strg HC odor.	
30.00									
	15 17 45	100.00			40.00	ML		SILT: 2.5Y5/4 lt olv brown, silt w/ minor fn sand, sl moist, non pl, md dense, FeOx stain, sl HC odor.	
35.00									
	10 12 34	100.00		MC-A008863 MC-A008894	50.00	ML		SILT: 5Y5/2 olv gray, sl moist, non pl, md dense, sl FeOx stain, sl HC odor.	
40.00				MC-C228703	270.00				
	9 17 24	100.00			41.00	ML		SILT: 2.5Y5/4 lt olv brown, sl moist, non pl, md dense, some FeOx stain and blk root casts, sl HC odor.	
45.00									
	7 10 19	100.00			3.00	SP		SAND: 2.5Y5/4 lt olv brown, vry fn to fn md graded subrnd sand w/ minor silt, moist, loose, some FeOx stain.	
50.00									
	10 15 23	100.00			38.00	SP		SAND: 10YR5/3 brown, fn to crs md graded subrnd sand, dry, loose, some FeOx stain and blk discoloration.	
55.00									

LOG OF BORING SA38SB02

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21611500 | LOCATION IDENTIFIER: SA38SB02 | SHEET: 3 of: 4

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
55.00									
	10 13 25	100.00		MC-A008965 MC-A008966 MC-A008895	0.00	SP ML		SAND: 10YR5/3 brown, fn to crs sd graded subrnd sand, dry, loose, some FeOx and blk discoloration. SILT: 5Y5/2 olv gray, dry, non pl, dense, minor FeOx stain and blk root casts.	
60.00				MC-C228704					
	15 25 50	66.00			0.00	ML		SILT: 2.5Y5/4 lt olv brown, silt w/ some fn sand interbeds, dry, non pl, dense.	
65.00									
	18 31 44	100.00			0.00	ML		SILT: 2.5Y5/4 lt olv brown, sl moist, non pl, dense, some blk discoloration.	
70.00									
	22 34 48	78.00			0.00	ML		SILT: 2.5Y5/4 lt olv brown, sl moist, non pl, dense.	
75.00									
	17 24 39	100.00		MC-A008967 MC-A008968 MC-A008896	0.00	SP ML		SAND: yllw brown, fn sd sorted subrnd sand, sl moist, dense, some FeOx stain. SILT: 7.5Y5/4 lt olv brown, dry, dense, some FeOx stain.	
80.00				MC-C228705					
	27 28 42	100.00			0.00	ML		SILT: 10YR5/3 brown, silt w/ app 10% fn sand, dry, non pl, dense, some FeOx stain and blk root casts.	
85.00									

LOG OF BORING SA38SB02

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21G11500 | LOCATION IDENTIFIER: SA38SB02 | SHEET: 1 of: 1

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
90.00	22 24 36	100.00			0.00	SP		SAND: 2.5Y6/3 lt yllw brown, fn to md and md to well sort subrnd sand, moist, dense, FeOx stain.	
95.00	16 27 34	94.00		MC-C228603 MC-C228602 MC-C228601 MC-C228706	0.00	ML ML		SANDY SILT: 2.5Y5/4 lt olv brown, silt w/ app 15% vry fn sand, moist, non pl, md dense, minor FeOx stain. SILT: 5Y6/1 gray, dry, non pl, dense, deep FeOx and blue stain.	
100.00									
105.00									
110.00									
115.00									

LOG OF BORING SA38SB03

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A		AIR FORCE BASE MCCLELLAN AFB
PROJECT NUMBER: 21G11500	LOCATION IDENTIFIER: SA38SB03	SHEET: 1 of: 4
thing: 362186.62 Easting: 2175821.17	Elevation and Datum: 80.00 Ft above mean sea level(ap	
Health and Safety: Level D with Tyvek	Date Started: 05/18/93	Date Finished: 05/19/93
Drilling Equipment: CME 750	Total Depth(Feet): 97.00	Depth to Grbundwater(Feet): NA
Drilling Method: Hollow Stem Auger	Borehole Diameter: 8.00 inches	
Sampling Method: 18 inch Split-Spoon Sampler	Monitoring/Vapor Extraction Well Total Depth (Feet): NA	As-Built In Figure: NA
Hammer Information: 140 lb with 30 in drop	Logged by: TL	Checked by: KRL KRL

Depth (Feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
0.00									
	10 12 16	85 00			1.00	GP		GRAVEL: gravel, sand, clay, tank backfill material	
5 00									
	12 23 20	100.00			1.00	GP		GRAVEL gravel, sand, clay, tank backfill material	
10 00				MC-C225905					
	15 35 50	100.00		MC-A008969 MC-A008970 MC-A008897	473.00	ML		SANDY SILT: 2.5Y4/2 dk gry brown, silt w/ app 25% sd sand, dry, non pl, dense, strg HC odor.	
15 00									
	5 15 18	100.00		MC-A008971 MC-A008972 MC-A008898	288 00	SP		SAND: 2.5Y5/3 lt olv brown, sd to vry crs well sorted subrnd sand, moist, loose, strg HC odor.	
20 00				MC-C225901					
	15 25 34	100 00			542 00	SP		SAND 2.5Y4/2 gry brown, sd subrnd sand, sl moist, md dense, strg HC/gasoline odor	
25 00									

LOG OF BORING SA38SB03

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21611500 | LOCATION IDENTIFIER: SA38SB03 | SHEET: 2 of: 4

Depth (Feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
25.00									
	10 20 35	100.00			524.00	ML		SILT: 2.5Y5/3 lt olv brown, dry, dense, HC odor, some FeOx stain.	
30.00				MC-A008873 MC-A008874 MC-A008899		SP		SAND: 10YR4/4 dk yllw brown, fn to md subrnd sand, moist, md dense.	
	8 23 35	100.00			507.00	ML		SILT: 2.5Y5/3 lt olv brown, silt w/ minor fn sand, sl moist, non pl, md dense, FeOx stain, strg HC odor.	
35.00									
	5 19 20	100.00			98.00	ML		SANDY SILT: 2.5Y5/3 lt olv brown, silt w/ app 20% fn sand, moist, loose to md dense, HC odor.	
40.00				MC-C225503 MC-C225502 MC-C225501					
				MC-C225902					
	23 35 50	100.00			43.00	ML		SILT: 10YR4/6 dk yllw brown, silt w/ minor vry fn sand, dry, non pl, dense, minor FeOx stain.	
45.00									
	9 14 18	100.00			9.00	SP		SAND: 10YR5/4 yllw brown, vry fn to md and md graded subrnd sand, moist, loose.	
50.00									
	9 12 20	100.00			1.00	ML		SILT 2.5Y5/3 lt olv brown, moist, non pl, loose, minor FeOx stain.	
55.00									

LOG OF BORING SA38SB03

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21G11500 | LOCATION IDENTIFIER: SA38SB03 | SHEET: 3 of: 4

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
55.00					1.00	SP		SAND: 10YR5/4 yllw brown, vry fn to fn sand, loose, some FeOx stain.	
	19 20 25	100.00			20.00	SP			
60.00				MC-C225506 MC-C225505 MC-C225504				SAND: 10YR5/3 brown, fn to md subrnd sand w/ tr silt, dry, loose.	
				MC-C225903					
	11 26 50	100.00			2.00	ML		SILT: 2.5Y5/3 lt olv brown, dry, non pl, dense.	
65.00									
	17 34 50	100.00			0.00	ML		SILT: 2.5Y5/3 lt olv brown, silt w/ some minor fn to md sand interbeds at 69.50 feet, dry, non pl, dense, minor FeOx stain.	
70.00									
	12 22 29	100.00			0.00	ML		SILT: 2.5Y4/4 olv brown, silt w/ minor md sand, dry, non pl, dense.	
75.00									
	6 11 22	100.00			5.00	SP		SAND: 2.5Y5/2 gry brown, fn subrnd sand, sl moist, loose.	
80.00				MC-C225709 MC-C225708 MC-C225707		ML		SILT: 2.5Y5/3 lt olv brown, dry, non pl, dense, some FeOx stain.	
				MC-C225904					
	15 19 27	100.00			0.00	SP		SAND: 10YR5/3 brown, md to crs sand, dry, loose, deep FeOx stain, downward fining to fn.	
85.00									

LOG OF BORING SA38SB03

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21G11500 | LOCATION IDENTIFIER: SA38SB03 | SHEET: 1 of: 1

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
85.00					0.00	ML		SILT: 2.5Y5/3 lt olv brown, dry, non pl, dense, minor FeOx stain.	
	7 16 23	100.00			0.00	SP		SAND: 10YR5/3 brown, fn to md and md sorted sand, sl moist, loose, FeOx stain.	
90.00									
	18 36 50	100.00		MC-C225703 MC-C225702 MC-C225701	0.00	ML		SILT: 2.5Y5/3 lt olv brown, dry, non pl, dense, FeOx stain.	
95.00				MC-C225906					
100.00									
105.00									
110.00									
115.00									

LOG OF BORING SA38SB04

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A		AIR FORCE BASE MCCLELLAN AFB	
PROJECT NUMBER: 21G11500	LOCATION IDENTIFIER: SA38SB04	SHEET: 1 of: 4	
rthing: 362174.19 Easting: 2175820.64		Elevation and Datum: 80.00 ft above mean sea level(approx.)	
Health and Safety: Level D with Tyvek		Date Started: 05/21/93	Date Finished: 05/21/93
Drilling Equipment: CME 750		Total Depth(feet): 97.00	Depth to Groundwater(feet): NA
Drilling Method: Hollow Stem Auger		Borehole Diameter: 8.00 inches	
Sampling Method: 18 inch Split-Spoon Sampler		Monitoring/Vapor Extraction Well As-Built Total Depth (Feet): NA In Figure: NA	
Hammer Information: 140 lb with 30 in drop		Logged by: TL	Checked by: KRL KRL

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
0.00									
	9 16 23	83 00			0.00	GP		GRAVEL: Pea gravel (to 1 inch) w/ sand and clay, tank backfill material.	
5 00									
	15 22 21	66 00			0.00	GP		GRAVEL: Pea gravel (to 1 inch) w/ sand and clay, tank backfill material.	
10 00				MC-C230501					
	10 32 48	100 00			0.00	ML		SANDY SILT: 2.5Y4/2 dk gry brown, silt w/ app 25% fn sand, sl moist, dense, strg HC odor.	
15 00				MC-A008975 MC-A008976 MC-A008900					
	7 18 40	100 00			0 00	ML		SILT: 2.5Y5/3 lt olv brown, dry, non pl, dense, FeOx stain, strg HC odor	
20 00				MC-A008977 MC-A008978 MC-A008901					
				MC-C230502					
	17 21 20	100 00			0 00	SP		SAND: 2.5Y5/4 lt olv brown, vry fn to fn sd graded subrnd sand, moist, md dense, strg HC odor.	
25 00									

LOG OF BORING SA38SB04

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21611500 | LOCATION IDENTIFIER: SA38SB04 | SHEET: 2 of: 4

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
25.00									
	10 23 45	100 00		MC-A008979 MC-A008980 MC-A008982	0.00	ML		SANDY SILT: 10YR4/3 dk brown w/ some 5Y5/1 gray interbeds, silt w/ app 25% md sand, moist, non pl, md dense, strg HC odor.	
30.00									
	11 22 20	100 00			0.00	SC		CLAYEY SAND: 5Y5/2 olv gray, vry fn to fn md graded sand w/ app 25% clay, moist, low pl, md dense, sl HC odor.	
35.00									
	10 12 19	100 00		MC-C230303 MC-C230302 MC-C230301	0.00	ML		SILT: 10YR5/4 yllw brown, sl moist, non pl, md dense, some FeOx and root casts.	
40.00				MC-C230503					
	20 33 35	88 00			0.00	ML		SILT: 10YR5/3 brown, silt w/ minor clay, moist, non pl, dense, some FeOx stain.	
45.00									
	7 15 25	100 00			0.00	SP		SAND: 10YR5/4 yllw brown, vry fn to fn, md graded, subrnd sand, moist, loose.	
50.00									
	13 16 27	100 00			0.00	SP		SAND: 10YR3/4 dk yllw brown, fn to crs, md graded, subrnd sand, sl moist, loose.	
55.00									

LOG OF BORING SA38SB04

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21G11500 | LOCATION IDENTIFIER: SA38SB04 | SHEET: 3 of: 4

Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
55.00									
	7 13 13	100.00		MC-C230306 MC-C230304	0.00	SP ML		SAND: 10YR3/4 dk yllw brown, fn to crs, md graded subrnd sand, sl moist, loose. SILT: 2.5Y5/3 lt olv brown, silt w/ minor clay, sl moist, md dense, some FeOx stain.	
60.00				MC-C230504					
	26 50 0	83.00			0.00	ML		SILT: 2.5Y5/3 lt olv brown, silt w/ minor clay, moist, non pl, dense, some FeOx stain.	
65.00									
	20 36 50	77.00			0.00	ML		SILT: 2.5Y5/3 lt olv brown, silt w/ minor clay, moist, non pl, dense, some FeOx stain.	
70.00									
	19 42 50	77.00			0.00	ML		SILT: 2.5Y4/4 olv brown, dry, non pl, dense, FeOx stain, some minor caliche.	
75.00									
	11 16 36	100 00		MC-C230309 MC-C230308 MC-C230307	0 00	SP		SAND: 10YR5/4 yllw brown, vry fn to fn subrnd sand, sl moist, md dense, FeOx stain.	
80.00				MC-C230505					
	16 30 50	100.00			0 00	ML		SILT: 10YR5/3 brown, dry, non pl, dense, FeOx throughout.	
85.00									

LOG OF BORING SA38SB04

PROJECT NAME: MCCLELLAN AIR FORCE BASE - OU A | AIR FORCE BASE MCCLELLAN AFB

PROJECT NUMBER: 21611500 | LOCATION IDENTIFIER: SA38SB04 | SHEET: 1 of: 1

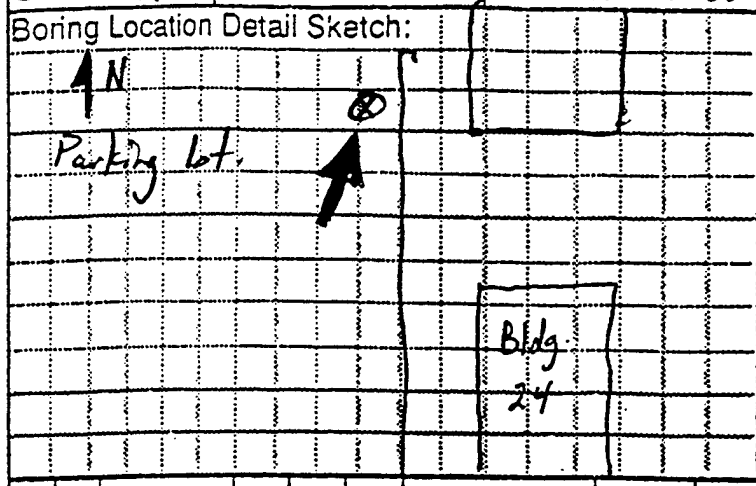
Depth (feet)	Blow Counts	Percent Recovery	Sample Interval	Sample ID	OVM Reading	USCS Code	Graphic Log	Lithologic Description	Remarks
90 00	22 22 23	100 00			0.00	SP		SAND: 10YR5/4 yllw brown, vry fn to fn, wd graded, subrnd sand, sl moist, loose, FeOx stain.	
95 00	18 50 0	83.00		MC-C230403 MC-C230402 MC-C230401	0.00	ML		SILT: 2.5YR5/3 lt olv brown, sl moist, dense, feOx stain.	
				MC-C230508 MC-C230506					
100 00									
105 00									
110 00									
115 00									

BORING LOG

Page 1 of 6

Project Name: McClellan	Project No: 27L44500	Geologist: B. Faulkner
OU No: A / Sector: IC 25	Site No: SA38	Boring No: SB006

Boring Location Detail Sketch:



Date Started: 10/2/96	Time: 1400
Date Finished: 10/3/96	Time: 1615
Drilling Contractor: WDC	
Driller's Name: Bryan Cook	
Drilling Method/Rig: HSA/CME 1050	
Diameter: 8" boring	well
Hammer: Wt: 280 lb.	Drop: 30 in.
Sampling Method: Splitspoon	H/S Protection Level: D
Monitoring Instrument/ Serial No.: (circle)	PID / FID / CGI / 56159-306
Well/Abandonment? Grout	
Total Depth: 95.5' bgs.	Groundwater Depth:

Blow Counts	Sample Interval / % Recovery	Grading: MAX SIZE	% Gravel	% Sand	% Fines	USCS	Lith. Code	Moisture Content	Sample Number	Sample Time (24 hr.)	PID/FID/CGI	Description/Notes: (LITHOLOGY: Munsell Color, grading angularity, density or consistency, plasticity, odors, staining, GW measurements, drilling notes.)
												Surface - 0.25' bgs Asphalt
						ML				1430	0.0	0.25' - 1.0' SILT WITH SAND: Olive brown (2. nonplastic, damp to moist, soft to hard.
												2.0 - 2.5' SILT WITH SAND: Olive brown (2.5Y trace gravel, nonplastic, damp to moist, s
						SM				1450	0.0	SAND WITH SILT: Olive brown (2.5Y 4/3) medium grain, trace coarse grain, trace gravel, subrounded to subangular, damp, noncemented to weakly cemented.
												/SILT: Dark yellowish brown (10YR 4/4) trace
12	90%					ML				1535	>5000	grain sand, nonplastic, moist, fuel-like odor, mottl
23						SP						SAND: Light yellowish brown (2.5Y 6/3) trace
45			(9.75 - 10.0)						MC-H006002			silt, fine grain, trace coarse grain, damp,
			(10.0 - 10.25)						MC-H006001			weakly to noncemented, fuel like odor,
			(10.25 - 10.5)						MC-H006003			mica flakes.
						ML				1545	>5000	SILT WITH CLAY: Brown (10YR 4/3) medium plasticity, no dilatancy, low toughness, very

JE JACOBS ENGINEERING GROUP

BORING LOG

OU No.: A | Site No.: IC25 SA38 | Boring No.: SB006 | Geologist: B. Faulkner

Blow Counts	Sample Interval & Recovery	Grading: MAX SIZE	% Gravel	% Sand	% Fines	USCS	Liquid Limit	Plasticity Index	Sample Number	Sample Time (24 hr)	PID/FID (ppm)	Description/Notes: (LITHOLOGY: Munsell Color, grading angularity, density or consistency, plasticity, odors, staining, GW measurements, drilling notes.)
												soft, fuel-like odor, homogeneous.
13	100%				ML					1558	9.0	SILT: Olive brown (2.5Y 4/3) nonplastic
22												slow dilatancy, moist, soft, trace clay
28			(19.5 - 19.75)						MC-H061201			toward top (19' ~~bgs~~ along augers), fuel
			(19.75 - 20.0)						MC-H006004			like odor.
			(20.0 - 20.25)						MC-H006005			
			(20.25 - 20.5)						MC-H006006			
			(Canister)						MC-H006101	1608	127	Gas sample interval: 21.5' to 21.7' alon
												SILT: Light yellowish brown (2.5Y 6/3) non
12	100%				~~SP~~ ML					1610	224	plastic, moist, soft, fuel-like odor.
16												SAND: Grayish brown (2.5Y 5/2) poor
25					SP							graded, subrounded to subangular.
												SAND: Olive brown (2.5Y 4/3) fine grain,
					SP/ML							silt, poorly graded, subrounded, moist, noncem
11	100%									1620	>9000	~~SILT Light olive brown (2.5Y 5/3) SP~~
25												SANDY SILT: Light olive brown (2.5Y 5/3)
30												fine grain sand, nonplastic, moist to da
												fuel-like odor, iron oxide stains.
12	100%				ML					1635	378	SILT: Light yellowish brown (2.5Y 6/3) no
13												plastic, damp, hard, fuel-like odor

JE JACOBS ENGINEERING GROUP

BORING LOG

OU No.: A | Site No.: IC23 SA38 | Boring No.: SB006 | Geologist: B. Faulkn

Blow Counts	Sample Interval & Recovery	Grading: MAX SIZE	% Gravel	% Sand	% Fines	USCS	Liq. Limit	Plasticity Index	Sample Number	Sample Time (24 hr)	PID/FID/ CGI	Description/Notes: (LITHOLOGY: Munsell Color, grading angularity, density or consist; plasticity, odors, staining, GW measurements, drilling notes.)
15												iron oxide stains.
11	100%				ML					1645	23	SILT: Light yellowish brown (2.5Y 6/3)
28												nonplastic, moist, firm to hard, fuel
47			(39.75 - 40.0)						MC-H006007			like odor.
			(40.0 - 40.25)						MC-H006008			
			(40.25 - 40.5)						MC-H006009			
			(Canister						MC-H006102	1705	5237	Gas sample interval 41.5' - 41.7' bgs.
												Terminate drilling until 10/3/96.
12	100%				ML					0759	52	SILT: Light olive brown (2.5Y 5/3)
23												nonplastic, moist, soft, iron oxide stain
46												
17	100%				SP					0807	34	SAND: Dark grayish brown (2.5Y 4/2) fine
10												grain, trace silt, fuel-like odor.
16					SP							= 49.5' - 49.75': SILT LAYR.
												SAND: Yellowish brown (10YR 5/4) fine
												grain, trace silt, fuel-like odor.
10	100%				SP					0816	21	SAND: Brown (10YR 4/3) fine grain, trace
16												medium grain, subrounded to subangular,

JE JACOBS ENGINEERING GROUP

BORING LOG

OU No.: A | Site No.: IC 23 SA38 | Boring No.: SB006 | Geologist: B. Faulkner

Blow Counts	Sample Length x Sample Recovered	Grading: MAX SIZE	% Gravel	% Sand	% Fines	USCS	Lithologic Code	Moisture Content	Sample Number	Sample Time (24 hr)	PID/FID/ CGI	Description/Notes: (LITHOLOGY: Munsell Color, grading angularity, density or consistency, plasticity, odors, staining, GW measurements, drilling notes.)
29												moist, noncemented
10	100%					SP				0830	12.2	SAND: Dark yellowish brown (10YR 4/4)
26												fine grain with medium grain subrounded t
41												subangular, damp, noncemented.
			(Canister)						MC-H061401		718	Gas sample interval: 61.8 - 62.0
												SAND: Dark yellowish brown (10YR 4/6) f.
												grain, subrounded to subangular,
15	100%									0855	~~92~~ 12	SILT: Light olive brown (2.5Y 5/3)
18												nonplastic, no dilatancy, damp, hard.
27												
14	100%									0905	10	SILT: Light olive brown (2.5Y 5/3) low
17											12	plasticity, slow dilatancy, low to medium
26			(70.0 - 70.25)						MC-H061202		~~B~~ 8	toughness, damp, soft to firm, fuel-like o
			(70.25 - 70.5)						MC-H061203			iron oxide stain.
10	100%									0940	14	SILT: Light olive brown (2.5Y 5/3) non plastic
15												moist to damp, firm, fuel-like odor

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BORING LOG

OU No.: 4 | Site No.: IC25 SA38 | Boring No.: SB006 | Geologist: B. Faulkner

Blow Counts	Sample Interval & Recovery	Grading: MAX SIZE	% Gravel	% Sand	% Fines	USCS	Hydrocarbon Odor	Moisture Content	Sample Number	Sample Time (24 hr)	PID/FID/CGI	Description/Notes: (LITHOLOGY: Munsell Color, grading angularity, density or consistency, plasticity, odors, staining, GW measurements, drilling notes.)
28												
14	100%					ML				0955	417	SILT: Light olive brown (2.5Y 5/3) non-plastic, damp to moist, soft to firm fuel-like odor, black stains.
28												
35												
			(Canister)							1020	735	Gas sample interval: 81.5' - 81.7' bgs.
11	100%					ML				1115	27	SILT: Light olive brown (2.5Y 5/3) non-plastic, damp, soft, mica flakes.
25												
33						SM						SAND WITH SILT: Light olive brown (2.5Y fine grain, moderately graded, subrounded to subangular, damp, noncemented, mic flakes.
												SILT: Light olive brown (2.5Y 5/4) low plastic damp, fuel-like odor.
9	100%					ML				1120	18	SAND: Dark yellowish brown (10YR 4/4) fine and medium grain, poorly graded, subrounded me noncemented, fuel-like odor, granitic mineralogy
15						SP						SILT: (as above) Higher PID readings in silt
27						ML						
9						ML			MC-H061205	1130		SANDY SILT: Light olive brown (2.5Y 5/3)
14			(94.25 - 94.5)						MC-H061204			nonplastic, damp.

(94.0 - 94.25)

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BORING LOG

OU No.: A | Site No.: IC25 SA38 | Boring No.: SB006 | Geologist: B. Faulkner

Blow Counts	Sample Interval % Recovery	Grading: MAX SIZE	% Gravel	% Sand	% Fines	USCS	Water Level	Moisture Content	Sample Number	Sample Time (24 hr)	PID/FID/ CGI	Description/Notes: (LITHOLOGY: Munsell Color, grading angularity, density or consistency plasticity, odors, staining, GW measurements, drilling notes.)
27						ML SM						SILTY SAND: Light olive brown (2.5Y 5/3) moderately graded subrounded to subangula damp, fuel-like odor.
			(Canister)						MC-H061403	1145	641	Gas sample interval: 97.6' - 97.8' bgs.
												Total distance drilled: 95.0' bgs.
												Total distance sampled: 97.8' bgs.
												Hole was drilled at an angle of (18°) off vertical.
												Actual vertical depth drilled = (auger length) cos(18°) = 90.4' bgs.
												Actual vertical depth sampled = (97.8') cos(18°) = 93.0' bgs.